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U. S. DEPARTMENT OF AGRICULTURE

# DISEASES OF SHEEP AND GOATS



**FARMERS' BULLETIN No. 1943**  
**U. S. DEPARTMENT OF AGRICULTURE**

**T**HE common infectious and noninfectious diseases of sheep and goats in the United States are considered in this bulletin. A section is included also on the poisoning of sheep and goats by toxic plants and chemicals.

Only the more important or characteristic symptoms which are of value in distinguishing one disease from another are given. Methods of treatment are outlined; special attention is directed, however, to preventive measures, so far as they are known. Information on disinfection and disinfectants may be found in Farmers' Bulletins 926 and 954. Especially when a serious disease is suspected, the owner is advised to call a veterinarian, if one is available, rather than trust too much to his own powers of observation, experience, and judgment. Serious losses may thereby be prevented.

This bulletin does not deal with parasitic conditions such as gid, grub in the head, stomach, lung, and intestinal-worm infestations, scabies, and similar ailments which are described in other publications of the Department.

This bulletin is a revision of and supersedes Farmers' Bulletin 1155, Diseases of Sheep.

# DISEASES OF SHEEP AND GOATS

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## INTRODUCTION

**S**HEEP and goats may become affected with infectious or noninfectious diseases some of which may cause serious losses from high mortality and unthriftiness. As in other animals, an abnormal condition or sickness always arises from some definite cause, such as infection, poison, faulty nutrition, heredity, mismanagement, or the presence of parasites. Some knowledge of the various causes of disease is necessary for an understanding of prevention, control, and treatment. The purpose of this bulletin is to familiarize sheep and goat owners with methods of preventing the common diseases of these animals as well as to promote understanding of control measures for diseases already established. The diagnosis and treatment of diseased animals should be left to a veterinarian.

Goats are more or less susceptible to the same diseases that affect sheep, popular opinion to the contrary. The two species are essentially

alike anatomically, and the differences in frequency of various diseases in them are relative, often being attributable to variations in methods of management. For example, some diseases are commonly more prevalent in goat dairy herds than in range sheep. In the same way, sheep crowded into feed lots or small farm pastures are more often affected by certain ailments than are goats on the range. Within the same species similar variations occur which are attributable to such factors as the locality, the space allotted to each animal, the kind and quantity of feed, the shelter, the water, the initial health of the individual animals, and the presence or absence of exposure to infection.

Prevention of disease is always wiser and more economical than treatment of affected animals after sickness appears in the flock, or band, as a large herd is called in the West. Anyone who has suffered severe losses from disease among his animals readily appreciates and accepts the importance of prevention. For those who have never experienced serious loss the practicability and economy of preventive measures cannot be too strongly emphasized. Prevention of some diseases can be accomplished simply by avoiding or eliminating the known cause. For example, enzootic, or congenital goiter, which commonly occurs in newborn animals wherever the soil, water, and forage are deficient in iodine, can be prevented by adding iodine salts to the mother's feed during pregnancy. The disease, anthrax, cannot occur unless *Bacillus anthracis*, the germ that causes it, is present. But in the so-called infected areas, anthrax is inevitable sooner or later unless preventive measures are taken. For all practical purposes this means vaccination of exposed animals every year.

If disease occurs in spite of precautionary measures, the affected animals should be isolated immediately. If the condition is infectious, its spread will thus be more or less controlled, depending upon the nature of the infectious agent and how it is disseminated. This is the first control measure for any infectious disease. With some infections, as contagious sore mouth, vaccination may be a practical procedure even after the disease makes its appearance, but to be very effective it must be done early in the outbreak before many animals in the flock have developed signs of sickness.

Before effective control measures and adequate treatment of a given disease can be applied, it is necessary to diagnose, or recognize, the ailment. Disease is usually accompanied by more or less definite changes in the affected animal's condition. These changes are known as symptoms. By means of close observation of symptoms alone it is possible to diagnose some diseases with reasonable certainty. Accurate information as to the history of the flock, its feed, environment, and methods of management is also a definite help to the veterinarian in establishing a diagnosis. In many cases, however, symptoms and history are indefinite. In such instances, especially, the nature of the trouble often cannot be determined without further information, such as may be obtained from post mortem examination or laboratory study. In very obscure cases repeated examinations of various kinds may be necessary before a diagnosis can be established.

Considerations of treatment follow diagnosis in turn. With all diseases of animals, the question of practicability of treatment from the economic standpoint is generally of first importance. Usually treatment is more successful and economical if applied early in the course of the ailment. But, under no circumstances would it be worth-

while or advisable to treat an animal affected with such a disease as rabies. On the other hand, if a rabid animal is destroyed too soon in the course of the disease, it becomes more difficult to diagnose the disease with certainty. It is sometimes wisest to kill an animal affected with an acute infectious disease and destroy the carcass, thus limiting the spread of the disease to other animals and avoiding uneconomical outlay of money, time, or effort.

One of the main objectives of the veterinarian, whether practitioner or livestock sanitary official, is to prevent disease. When disease occurs, as it will to some extent even under the best of conditions, it is his job to control loss so far as possible, as well as to treat affected animals, if this is feasible. Too often, a veterinarian is never consulted by the livestock man until after some of his animals become diseased. Even then, some owners delay calling in professional aid until after various kinds of lay treatment have been tried. Either practice detracts from the fullest possible advantage to be derived from veterinary service.

## INFECTIOUS DISEASES

### ABORTION

The term "abortion" is here applied to the expulsion of either living or dead young from the uterus before the normal time of birth. As



FIGURE 1.—Liver from an aborted sheep fetus showing abnormal, light-colored spots caused by *Vibrio fetus*.

with other species of animals, the common cause of abortion in ewes and does is infection. As discussed under brucellosis, Malta fever is sometimes the cause in goats. In ewes the most common cause is the germ known as *Vibrio fetus*. Abortions due to *Vibrio fetus* usually occur about a month before time for normal lambing. The lambs are stillborn; their livers contain numerous, irregularly shaped, necrotic spots, varying in size from a pinhead to a large marble (fig. 1).

Other germs classified as *Salmonella*, *Pasteurella*, *Listeria*, and "coliform" organisms may be responsible. In addition, moldy feeds are sometimes accused, though definite proof of their relationship is rarely available. Finally, abortion may occur in the course of various epizootic diseases or as a result of mismanagement, including excessive handling or rough treatment of animals in advanced pregnancy, and vitamin or other deficiencies in the ration. A deficiency of vitamin A in the feed of either ewes or does is likely to result in considerable reduction in the lamb or kid crop. Many young are born weak and some are still-born.

The loss of lambs or kids before full term, whenever or however it occurs, is ample justification for immediate professional attention. The exact determination of cause in each case may require considerable study.

Aborting animals should be isolated promptly from the remainder of the pregnant band, and the dead lambs or kids and the afterbirths should be burned or buried in quicklime. Contaminated lambing or kidding quarters should be thoroughly cleaned and disinfected. Change of feed may be desirable. Removal of pregnant animals from sheds or barns to pastures or range may be advisable during mild weather. Clean, uncontaminated water should be provided.

#### ACTINOBACILLOSIS

This disease, as it has been reported in sheep in the United States, manifests itself by the presence of small, pus-filled pockets in the regions about the head, under the skin, or in the underlying lymph nodes. Actinobacillosis is comparatively rare in sheep in this country, though common in cattle. It is mentioned here to be considered in connection with differential diagnosis in such diseases as caseous lymphadenitis, tuberculosis, coccidioidomycosis, actinomycosis, and infections due to the common pus-producing micro-organisms. Also, the possible spread of actinobacillosis from cattle to sheep, or vice versa, should not be overlooked.

**CAUSE.**—The direct cause is the germ, *Actinobacillus lignieresii*, which appears to gain entrance to the body tissues through small wounds inflicted by the sharp awns of such grasses as foxtail and needlegrass, cactus spines, or other harsh feeds.

**SYMPTOMS.**—Swellings appear about the lips, the lower portion of the head, and along the neck. Some of these areas may be scabbed over through the rupture of the abscesses and the matting of the wool by the discharges. The pus may be confined within an unruptured, tough, fibrous capsule. It is greenish yellow in color and stringy in consistency. Small, grayish-yellow flakes may be seen in the material.

The disease can be definitely diagnosed only in the laboratory.

**TREATMENT.**—In most cases treatment is not practical or economical and it is advisable to dispose of infected animals for slaughter before the disease becomes advanced.

In cattle the administration of iodine in various forms, either with or without the aid of surgery, is a successful form of treatment. In the case of valuable rams or other sheep, such treatment may be advisable in some instances.

## ACTINOMYCOSIS

This disease, due to the funguslike organism, *Actinomyces bovis*, may be confused with actinobacillosis. It is rarely encountered in sheep and goats though common in cattle.<sup>1</sup>

## ANTHRAX (CHARBON)

Anthrax is one of the most deadly diseases known. Besides sheep and goats, other animals, such as cattle, horses, and swine, may contract the disease, and man is also susceptible.<sup>2</sup>

Fortunately, it is not widespread in the United States but occurs in certain sections, which become known to livestock sanitary officials, practicing veterinarians, and livestockmen as "anthrax districts." In such areas the soil is infected, remaining so for years, largely through the ability of *Bacillus anthracis*, the germ causing the disease (fig. 2), to develop spores, or seedlike forms. These are capable of surviving

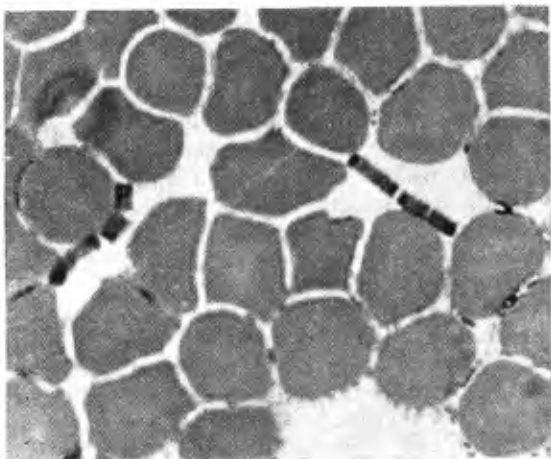


FIGURE 2.—Anthrax bacilli (dark, rodlike objects) in blood stream. The larger, gray objects are blood cells. Magnified about 1,600 times.

for a long time outside the animal body, and render the premises so contaminated a practically perpetual hazard to livestock.

The disease is generally most destructive on low-lying, poorly drained lands. There the moist conditions are more favorable for perpetuation of the infection, which is presumably carried up from the soil by the growing grasses or other vegetation. On the other hand, unusually dry seasons appear to be conducive to the spread of the disease, probably because the animals being pastured are required to graze closely, even down into the soil around the roots of the plants. Flies and other insects, as well as carrion-eating birds and animals, or even feed from anthrax districts, may introduce the infection to previously clean premises.

**SYMPTOMS.**—Sometimes the disease is so acute that nothing wrong is suspected until dead animals are found. At other times, animals may be noticeably sick for only a comparatively short time, perhaps but a

<sup>1</sup> For further details consult U. S. Dept. Agr. Cir. 438, Lumpy Jaw, or Actinomycosis.

<sup>2</sup> For further information see Farmers' Bulletin 1736, Anthrax.



few hours; they then suddenly collapse and die as if suffering from some acute form of poisoning. High fever is invariably present. Frequently there is rapid, labored breathing and extreme weakness. The mucous membranes of the mouth and nostrils commonly develop a dull, bluish color. Bloody discharges from these openings and the anus may appear. Sheep frequently develop convulsions as death approaches.

**DIAGNOSIS.**—After death the carcass bloats and decomposes unusually quickly. Frothy, bloody discharges may be found at the natural body openings. Even the veterinarian is justly reluctant to open such a carcass for post mortem examination unless this is necessary. The blood is teeming with the germs of the disease, and one drop contains enough of them to infect a whole herd under suitable conditions, not to mention the fact that one cutting into or examining such a carcass is apt to contract the disease himself unless special precautions are taken. Usually the experienced veterinarian is enabled by the history and appearance of sick and dead animals to establish a practical diagnosis in cases of anthrax.

If post mortem examinations are desired, none but the veterinarian should undertake the task. Hemorrhages of variable size may be present any place in the carcass. The blood is usually black and tar-like and fails to clot. The spleen is invariably considerably enlarged, softened, and much darker than normal in color. Definite diagnosis of anthrax depends upon bacteriologic examination of tissues from affected animals by a properly equipped laboratory. For this purpose an ear may be severed from the carcass, a swab may be taken from the blood, or portions of organs may be employed. Special care must be taken in collecting and shipping such specimens.

**TREATMENT.**—The treatment of anthrax is, generally speaking, an impractical procedure. There is no known specific medicinal remedy for the disease. On the other hand, anti-anthrax serum in large repeated doses may be properly used in selected cases or in especially valuable animals. Often the most practical and economical procedure in the long run is to kill affected animals immediately.

**PREVENTION.**—Vaccination with one or more of the several available kinds of biological products for the prevention of anthrax constitutes the first line of defense against the disease in areas where the infection is known to exist. In such areas it is a well justified and common practice to have animals vaccinated every year. The choice of products and method of administration are highly technical matters that should be entrusted only to the veterinarian. Some States prohibit the use of most anthrax biological products by anyone else.

An important matter to be assiduously carried out in anthrax control is the immediate and thorough disposal of the carcasses, preferably by burning.<sup>3</sup> This should be done without any mutilation or cutting of the carcasses, and no attempt should be made to salvage pelts.

If there is any reason to suspect the presence of anthrax there should be no delay in consulting a veterinarian. In some States, if anthrax is diagnosed, a quarantine of the premises may be established by law. Movement of animals from or to affected premises should be pro-

<sup>3</sup> Various methods of carcass disposal and other phases of control are discussed in detail in Farmers' Bulletin 1736.

hibited unless and until authorized by the livestock sanitary authorities. A thorough cleaning and disinfection should follow the removal of the dead animals.

#### ARTHRITIS (JOINT ILL)

This infectious disease, sometimes called rheumatism, consists in inflammation of the joints. It occurs chiefly in lambs. In these the common cause is infection by one of the following germs: *Erysipelothrix rhusiopathiae*, which causes swine erysipelas and infections in other animals, including man; streptococci, *Corynebacterium pyogenes*, and other micro-organisms which form pus.

**SYMPTOMS.**—Stiffness and general unthriftiness are the first signs of the disease. An affected animal moves hesitantly and lies down much of the time. When it is forced to move, one leg may be carried, no weight being placed on it. The leg joints are usually enlarged and may be very tender when pressed. In addition to the joints the internal organs may be involved. The disease is to be differentiated from rickets, which is nutritional in origin, and from the condition of so-called stiff lambs, which is discussed elsewhere.

**OCCURRENCE.**—The disease is closely associated with insanitary surroundings, particularly at lambing time. Lambing sheds used repeatedly for season after season without thorough cleaning and disinfection commonly contribute to the occurrence of the disease. Carelessness in docking, castration, ear-marking, and the neglect of other wounds may allow the germs to enter the body. Infection commonly occurs also through the navel cord when it ruptures at birth.

**PREVENTION AND TREATMENT.**—Treatment is rarely satisfactory or economical. Generally speaking, the most practical mode of dealing with the disease is to destroy the affected animals, although sulfanilamide has recently been reported to be efficacious in streptococcic arthritis in lambs. If treatment is attempted, affected animals should be isolated.

If the weather requires that lambing be carried out in buildings, these should first be thoroughly cleaned and disinfected and then maintained in a sanitary condition. Lambing on clean pastures will prevent much of this trouble, as will cleanliness in castrating, docking, and ear-marking.

Infection through the navel can be almost entirely eliminated by disinfection of the stump of the navel cord immediately after birth. Tincture of iodine U. S. P. is the preparation usually used. It is applied in a small cup or wide-mouthed bottle containing the solution, placing the container over the stump and pressing it against the lamb's belly while the lamb is turned over on its back. Then when the lamb is again placed on its feet, the cup or container is removed with little waste of the solution.

#### BLACK DISEASE (INFECTIOUS NECROTIC HEPATITIS)

This disease has been so named because of the purplish-black discoloration of the pelt when it is removed from the dead animal. Actually such discoloration may occur in other diseases and commonly accompanies the putrefaction following death, so it cannot be accepted as an infallible sign of black disease. There is no connection between this disease and so-called blackleg.

Black disease was first studied in Australia. For a number of years its presence was only suspected in the United States, but the affection has in late years been definitely identified in this country.

**CAUSE.**—As determined in Australia and apparently confirmed in the United States, two conditions are required for the development of the disease: First, an invasion by liver flukes (*Fasciola hepatica*) and, second, the presence of the germ, *Clostridium novyi* (*Clostridium oedematiens*) which forms a powerful, death-producing poison in the liver substances.

Practically speaking, the disease is confined to sheep on swampy, poorly drained lands where liver-fluke disease is prevalent. - Usually the fattest and thriftiest appearing animals are those which develop the disease. Lambs or very old sheep are seldom affected.

**SYMPTOMS.**—From the clinical signs the malady may be confused with anthrax, since it ordinarily runs a very rapid course, and illness of short duration is invariably followed by death. Apparently normal sheep corralled at night are found dead in the morning. If an affected flock is watched closely, however, some animals may be seen to be sluggish and lag behind when driven. When examined, there is usually some fever but little else of diagnostic significance.

Because a dead sheep undergoes putrefaction very rapidly, post mortem examination must be made soon after the death of the animal to detect the changes due to the disease. In an animal dying of black disease, the blood vessels of the skin are usually found full of dark-colored blood. When the skin dries it becomes very dark in color. Except for the presence of considerable fluid in the abdominal cavity and in the sac about the heart (pericardium), the organs appear to be quite normal. Closer examination will reveal, however, that the liver is darker and a little larger than normal. Well-defined, light-colored, grayish or yellowish areas, varying in size from a pin-head to a walnut, are found. These are attributed to the toxin of the germ. The yellowish-gray necrotic areas are surrounded by a darker bloody zone. The liver may also show evidence of recent invasion by young flukes. Upon close examination, very small flukes may be found under the covering membrane of the organ, either in the vicinity of the necrotic areas or within small bloody splotches elsewhere in the liver.

**PREVENTION.**—From a practical standpoint the best means of prevention is through control of liver flukes. This involves treatment of fluke-infested sheep, change of pasture or fencing or drainage of swampy areas, and other means of destruction of the snails through which the flukes pass in the course of their development.<sup>4</sup> Several biologics made with cultures of *Clostridium oedematiens* have been used for prevention, mostly in foreign countries. The products used include various kinds of bacterin and antioedematiens serum.

There is no known remedy for the disease once it develops.

#### BLACKLEG

This is chiefly a disease of young cattle but sometimes develops in sheep as a result of wound infection, under which heading it is discussed in this bulletin.

<sup>4</sup> Further information concerning liver flukes may be obtained from Farmers' Bulletin 1330, Parasites and Parasitic Diseases of Sheep.

BRUCELLOSIS<sup>5</sup>

This term covers infection due to germs belonging to the genus known as *Brucella*. Organisms of this class are responsible for brucellosis, also known as Bang's disease and infectious abortion, in cattle and other animals, Malta fever in goats, and undulant fever in man who contracts the disease directly or indirectly from infected animals or their products.

Abortion due to germs of the *Brucella* type has been reported in sheep from several foreign countries but has never been conclusively proved to exist in the United States. Goats in this country, however, do sometimes have Malta fever, so-called because of its first description on the Island of Malta.

**SYMPTOMS.**—A flock of goats or individual animals infected with *Brucella* germs may show no outward signs of the infection unless examined periodically over a period of months. But during the course of the disease through the flock, abortions are common, occurring usually during the fourth month of pregnancy. In some animals, milk secretion is retarded and the udder may become inflamed and hardened temporarily. Other animals become lame. Severe inflammations of the eyes and lungs have also been described.

**DIAGNOSIS.**—Suspicion as to the presence of brucellosis can be verified by tests of the animals' blood. In herds found to be infected, repeated tests are usually desirable. The test, known as the aggluti-



FIGURE 3.—A herd of healthy goats, tested for brucellosis.

nation test, is the same as that commonly used for brucellosis, or Bang's disease, in cattle. Milk from infected animals is dangerous unless pasteurized or boiled. Persons caring for infected animals are exposed to the danger of infection.

<sup>5</sup> See Farmers' Bulletin 1871, *Brucellosis in Cattle*.

**PREVENTION.**—The chief method is frequent blood testing. Newly acquired animals should always be subjected to test, preferably by an authorized agent of the State, before they are added to healthy goat herds (fig. 3). This is especially desirable in goat dairies, and is mandatory in some States. The reacting animals should either be isolated pending replacement or slaughtered under veterinary supervision.

#### CASEOUS LYMPHADENITIS (PSEUDOTUBERCULOSIS)

This is a very common chronic disease of aged sheep, which also affects goats. It is sometimes seen in young animals but usually in a milder form. The germ which causes the disease, *Corynebacterium ovis*, or *Bacillus Preisz-Nocard*, produces an odorless, greenish-yellow to grayish-white pus of pasty or cheeselike character, chiefly in the lymph nodes of the body. Due to this, large swellings may develop about the jaws, in front of the shoulder, in the flank, or anywhere in the body. Abscesses may develop in the lungs, liver, spleen, intestines, kidneys, or even the udder or testicles. These are not to be confused with the lesions of tuberculosis.

The disease progresses very slowly, causing no appreciable damage except in advanced cases, usually in aged animals, when serious loss of weight, general weakness and unthriftiness, and finally death result. A chronic intoxication caused by accumulation of poisons formed by *Corynebacterium ovis* has been described under the name of mal rouge in France but the condition has not been reported in the United States.

**TREATMENT.**—There is no known successful means of curing affected animals. Markedly affected animals are usually sent to slaughter. Severely involved carcasses must be condemned by the inspecting veterinarian.

**PREVENTION.**—This is best effected by forestalling entrance of the infection into the body through wounds. Caseous lymphadenitis may be acquired also through inhalation of infected material or by eating contaminated feeds. *Corynebacterium ovis* is a very resistant organism, being capable of surviving in corral litter and dust for months another of the many reasons for sanitation of buildings and corrals used for sheep and goats.

Since the organism is believed to gain entrance to the body chiefly through shearing cuts and ear-marking, docking, and castration wounds, these operations should be carried out in as clean a manner as possible. A practice used by some operators is to dip shearing knives or blades into an antiseptic solution before using them on another animal.

#### COCCIDIOIDAL GRANULOMA (COCCIDIOIDOMYCOSIS)

This disease, due to a fungus known as *Coccidioides immitis*, has been reported in cattle, sheep, wild rodents, and man in the United States, and may occur in goats. It is included in this discussion of diseases not because of its seriousness in the few sheep in which it occurs, but rather to point out its existence.

The disease occurs in sheep usually as a mild, chronic, localized process in one of the lymph nodes. As compared with its incidence in man and in cattle, the disease is very rare in sheep so far as is

known. The affected tissues upon casual examination have an appearance suggestive of tuberculosis, actinomycosis, and actinobacillosis, and may even resemble some instances of caseous lymphadenitis.

Suspicious cases of the disease should be subjected to laboratory examination, which includes microscopic observation and culture of the causative organism.

#### DYSENTERY

The term, dysentery, as here applied refers to an acute inflammation of the intestines which results in frequent passages of unusually fluid droppings, sometimes containing blood and mucus.

The causes are varied but may be classed as bacterial, parasitic, and environmental. Among the first are *Salmonella* and "coliform" organisms and *Clostridium welchii*. Coliform organisms and *C. welchii* are involved in the disease known as lamb dysentery, which is the form of the disease that causes most losses.

Lamb dysentery, or lamb scours, appears in suckling lambs during the first few days of life, usually within the first 48 hours. The lambs are suddenly prostrated, and develop a profuse, foul-smelling grayish-white or yellowish diarrhea. In severe, cold, or wet weather the disease is aggravated, and many lambs die after only 1 or 2 days of illness. Those which do not die recover slowly and develop poorly.

The primary cause of lamb dysentery is filth, through which "coliform" organisms and *Clostridium welchii* operate. The trouble is commonest when shed-lambing is practiced. Under these conditions the most exacting care is necessary if trouble from the disease is to be avoided. Before lambing, "tagging" (clipping the wool from about the udder and legs) of the ewes and thorough cleaning and disinfection of the buildings and pens to be used are advocated. Buildings and pens for lambing especially should be on well-drained land and so constructed as to receive an abundance of direct sunlight inside the building. A small quantity of clean, dry bedding should be provided regularly, dampness and cold being especially bad for young lambs. Soiled bedding should be replaced frequently by fresh, dry material. Some operators use no bedding but provide slatted floors in the lambing pens. Some western sheep owners have found that it is to their advantage to have the lambing program supervised, or at least planned, by a veterinarian.

If, despite all precautions, the disease appears, the sick lambs should be isolated from the others, providing separate attendants for each group. Various forms of treatment have been used, from so-called intestinal antiseptics to the feeding of what is known as culture milk (sterilized cow's milk in which *Lactobacillus acidophilus* has been planted in the laboratory). Great care must be taken to prevent the contamination of culture milk with other organisms and to see that it is fresh and otherwise suitable when used. To this end, close veterinary supervision is very desirable if not necessary.

Following lambing each season, the lambing sheds, pens, and corrals should be thoroughly cleaned and disinfected, left exposed to the air and sun, and preferably kept free of sheep until the next year.

*Salmonella aertrycke* has been found by Colorado investigators as the cause of so-called paratyphoid dysentery in at least three sizeable outbreaks in feed-lot lambs. In such cases, serious delays in shipping,

with attendant feeding irregularities, appeared to be major contributory factors. Experimentally, it was found impossible to infect a regularly fed, well-filled sheep, while fasted sheep readily developed the typical disease. Regular feeding and watering of lambs in transit are accordingly advanced as the best means of preventing this form of dysentery.

Parasitic dysentery is caused by coccidia and various worms, which are discussed in a publication on parasitic diseases.<sup>6</sup>

So-called environmental dysentery arises chiefly from indiscreet feeding, such as the forcing of feeder animals without allowing sufficient lapse of time for adaptation to change in feed. The obvious remedy is to reduce, adjust, or change the feed to allow a fresh start for the animals.

#### ECTHYMA CONTAGIOSA (SORE MOUTH)

This is an acute disease affecting lambs and kids chiefly, and is caused by a filtrable virus, a substance which, unlike ordinary disease-



FIGURE 4.—A lamb affected with sore mouth.

producing bacteria, can traverse the pores of certain specially made filters.

**SYMPTOMS.**—As the term, sore mouth, implies, the disease affects the mouth and lips chiefly, though other parts of the body are sometimes simultaneously involved. Small blisters first form, then become pustules, which rupture. Following this, raw, ulcerlike lesions appear. These then become coated with thick wartlike grayish-brown scabs (fig. 4). By this time the lips are swollen, painful, and bleed easily.

<sup>6</sup> Various internal parasites are discussed in Farmers' Bulletin 1330, Parasites and Parasitic Diseases of Sheep.

The lips are so sore that the animals nurse or eat grain or hay only sparingly. Sometimes the disease involves the eyelids, leading to severe inflammation of the eyes.

Unless complications set in, recovery follows in most cases in about 2 weeks after the first appearance of symptoms. But when bacteria, especially *Actinomyces necrophorus*, invade the lesions, serious trouble and considerable death loss may result. In these cases severe lesions may develop in the mouth, throat, stomach, lungs, or liver.

**PREVENTION.**—The most effective means of prevention is by vaccination, which consists in applying a vaccine made from material from affected animals to scratched areas on the skin, usually over the inside of the thigh. The vaccine, as well as the scabs of the disease, contains the living virus, and care must be used in applying the product to prevent needless spread of the infection.

Vaccination is most effective when administered at least 10 days before anticipated exposure of the animals, which usually takes place during shipment or on arrival at old, repeatedly used feeding pens. After the disease has made its appearance in the band, vaccine is of little or no value except where only a small percentage of the animals are affected.

**TREATMENT.**—It is desirable to remove the affected animals from the flock. In many cases an animal will recover without any treatment whatever, but to forestall secondary infections with bacteria the crusts may be removed and a mild antiseptic substance applied. Water should be kept before the animals at all times, and the feed should not be too dry or coarse. During and after an outbreak of the disease, the premises should be cleaned and disinfected. There is no specific medicinal remedy.

#### FOOT ROT

This disease is a potential hazard wherever sheep are kept. A similar, if not identical, disease affects goats.

**SYMPTOMS.**—Usually the first evidence of the disease observed is lameness. Before or during the initial lameness, redness and swelling just above the hoof, between the toes, or at the bulb of the heel may be detected. A watery fluid, changing to a thin fluid pus with a characteristic foul odor, exudes from the swollen areas. If the disease is not stopped, the sole or even the entire hoof wall may eventually be undermined, and even the bones and ligaments may be involved. The feet, which often grow excessively and become hard and brittle, are especially subject to infestation with maggots. In some cases the hoof wall sloughs from the foot.

The disease may attack one or more of the feet. Lameness and pain may be so intense that the affected animals refuse to stand. Feeding is greatly limited, especially on the range, and severely affected animals become very thin and weak, and some may die.

Occasionally the affected animals appear to improve gradually under some conditions even without treatment. In such cases recovery seems complete but infection may still lurk within the apparently healed feet. Such animals, as well as those seriously affected, are a hazard to other sheep with which they come in contact.

The disease is particularly troublesome if it appears in feedlots or small, crowded farm flocks, but may cause serious damage even in



range bands. Extended wet weather or poorly drained or swampy lands are favorable for the disease, while dry weather and light, well-drained soil reduce the trouble. When conditions are favorable for the disease, it is readily transferred from sick to healthy animals by exposure of the feet to the discharges.

**CAUSE.**—Originally the germ, *Actinomyces necrophorus*, which has been mentioned in connection with sore mouth, was generally conceded to be the causative organism. Later investigations have aroused question, however. An organism called *Fusiformis nodosus* has lately been assigned the primary role by some investigators. It is generally agreed, however, that the necrosis bacillus, as well as spirochetes and miscellaneous pus-forming micro-organisms, probably play accessory roles.

**TREATMENT.**—Foot rot is amenable to treatment, but diligence and attention to all necessary details are essential for best results. Attention to one detail at the expense of others may result in failure.

It is first very desirable, if not necessary, to separate the healthy from the affected animals. In order to do this, each animal in the band must be closely examined.

The feet of all animals should be trimmed to remove completely all excess growth of hoof and all necrotic or dead tissue so as to expose the depths of the infectious process. The trimming or paring may be done with a sharp hoof knife, pruning shears, or heavy pocket knife. Hard, dry hoofs may require hoof nippers such as are used on horses' feet.

After the animals with evidence of foot rot have been separated, they should be placed in dry, freshly cleaned and disinfected quarters apart from the unaffected animals. In some cases the isolation may be best effected by moving the healthy sheep to ground that is known to be uninfected.

Separate attendants and the prevention of any direct contact between the two groups are desirable. If the same attendants must care for both flocks, the healthy animals should be completely attended to first. After attending the sick animals later, the attendant should cleanse his person and sterilize all equipment and instruments used.

After the feet have been properly trimmed, antiseptic substances should be applied. If few animals are to be handled, the antiseptic may be applied with a cotton swab or brush or preferably by soaking each foot in a bucket or other receptacle containing it. Large numbers of animals are best handled by the use of a trough of wood or other convenient material about 12 inches wide and 6 to 8 inches deep with splash boards closely fitted at the sides to prevent wastage of the solution. The length of the trough depends upon the number of animals to be treated, usually being sufficient to hold at least 8 or 10 at a time. Sloping panels are usually placed at each side of the trough, and wings extended out from the entrance to facilitate handling the animals.

The antiseptic to be used is largely a matter of choice, since almost any efficient antiseptic agent is effective once the seat of the trouble has been exposed by paring the foot to allow direct contact of the antiseptic. The length of time the sheep should remain in the foot bath and the optimum interval between treatments depend upon the nature and strength of the antiseptic used and the extent of the disease, which are matters for the decision of the attending veterinarian.

The substance most widely used in treating foot rot is a solution of copper sulfate, or bluestone. The chemical dissolves more readily if powdered and if hot water is used. Because the substance is corrosive, earthenware or enameled vessels should be used in preparing the solution. Solutions varying from 10 to 30 percent in strength (about  $\frac{4}{5}$  to  $2\frac{1}{2}$  pounds per gallon of water) are used. The stronger the solution the more irritating it is, though often the strongest possible solution (30 percent) is preferable.

Some cases respond well to 2 to 10 percent solutions of formaldehyde solution (U. S. P.) similarly applied. Both formaldehyde solution and copper sulfate solution are very irritant and should be handled with care. Sheep should not be permitted to lie down in them during treatment.

Ordinarily the sheep are compelled to stand in the antiseptic for at least 2 minutes, but the length of the period may be increased, particularly if weak solutions are used.

In practice some operators place a trough containing clean water at the entrance to the trough of antiseptic to wash foreign material from the feet before the animals enter the medicated bath.

In cases where the disease is severe and the feet are very sensitive, clean, soft dressings, and some substance such as oil of pine tar may be applied.

If the disease is neglected, either in individual animals or in bands, the most economical procedure may be to send the animals to slaughter where veterinary inspection is maintained.

**PREVENTION.**—Because the infected sheep is considered as the greatest source of trouble, any sheep to be added to a normal flock from outside sources should be held in quarantine for at least a month. This not only helps to eliminate possible introduction of foot rot but other diseases as well, and permits a period for the animals to adapt themselves to new surroundings and conditions.

Sheep should preferably be obtained from sources known to have been free of foot rot for at least 6 months previously. Sheep treated for the disease should not be returned to the healthy flock until complete healing has taken place and absence of the infection is reasonably assured; an observation period of at least 2 months is recommended.

All bedding, hoof trimmings and dressings should be burned or otherwise destroyed regularly during the time diseased sheep are being cared for. Barns, sheds, and corrals which have been used by infected sheep should be thoroughly cleaned and disinfected before permitting access by healthy sheep. Where practicable, muddy corrals and pastures should be drained.

Just how long the infection may remain in soil depends upon several factors. In northern latitudes, infected ground is generally conceded to be safe for clean sheep after 4 months' exposure to freezing weather. In light, well-drained soil exposed to the summer sun in the absence of rain the infection probably does not persist for so long a time, and, under such conditions, corrals may be generally considered safe if sheep are excluded for 2 months.

As an added measure of precaution, the apparently healthy animals from an infected band are sometimes run through the antiseptic foot bath. When this is done, fresh solutions and not those used for infected sheep should be used.

When lameness first appears in a flock, it is sometimes difficult to determine if true foot rot is the cause of the trouble. But if lame animals are promptly isolated in all cases, the possibility of spread of infection to the rest of the flock is materially lessened. Moreover, observation and treatment of such animals is greatly facilitated, regardless of the cause.

#### HEMORRHAGIC SEPTICEMIA (PASTEURELLOSIS)

According to many authorities, the germ *Pasteurella oviseptica* which is held to be responsible for this disease, is a common inhabitant of the healthy animal body. The micro-organisms appear to cause disease only when the animal carrying them is subjected to some unfavorable influence, such as protracted, severe, wet, or cold weather, or a rigorous and exhausting journey by rail, ship, or truck, during which time feeding and watering may be irregular or insufficient.

Hemorrhagic septicemia is an uncommon disease, except in feed-lot lambs. The disease usually appears in such animals within the first few days after arrival in the feeding pens. From year to year, the incidence of the disease varies; in some years there are many cases, in others very few, apparently depending somewhat upon the severity of the conditions under which shipping occurs.

**SYMPTOMS.**—Fever and depression are among the first indications of the disease. In an affected flock there are usually considerable sneezing and coughing, more rapid breathing than normal, and discharges from the eyes and nose.

The malady assumes two forms as follows: The acute, which may cause death within 24 hours; and the chronic, which results in pneumonia lasting from a few days to several weeks. Lameness is a common symptom, according to some observers. In extreme instances, as many as one-half of the flock may sicken over a period of a few days and the death loss may reach 10 percent of the entire group.

The affected animals eat little or nothing at all during the illness and there is considerable loss of weight, so that even if the death loss is not great the feeding program is greatly upset by the presence in the pens of a varying number of thin, unthrifty animals. After the first few days when new cases occur each day, the disease in the flock ordinarily subsides of its own accord, especially during mild weather.

In those animals which die shortly after an acute sickness, hemorrhages are commonly found under the skin and in various organs, chiefly within the chest. A considerable quantity of clear, straw-colored fluid is frequently found in this cavity. In those cases in which death occurs after an illness of several days, pneumonia is the condition usually found at post mortem examination. The lungs are mottled in appearance, dull red to gray in color, and some areas are solidified.

**DIAGNOSIS.**—Lesions closely resembling those of acute hemorrhagic septicemia are commonly found in many other diseases. Many errors in diagnosis have been made, using the presence of hemorrhages as the sole diagnostic evidence. The experienced veterinarian can usually accurately diagnose hemorrhagic septicemia after considering history, symptoms, and lesions, but final diagnosis should rest wherever possible on bacteriological proof.

**PREVENTION AND TREATMENT.**—Hemorrhagic-septicemia bacterin, if expected to be of benefit as a preventive, should be administered at least 2 weeks before shipping. Anti-hemorrhagic-septicemia serum may be administered if a shorter interval is necessary but the immunity resulting therefrom is of relatively short duration.

Improved shipping conditions, including regular stops for feed and water and prevention of overcrowding and exposure, tend to decrease likelihood of the development of the disease.

Hemorrhagic-septicemia bacterin is of no known value after a sheep sickens. Anti-hemorrhagic-septicemia serum, if given early in liberal, repeated doses, may be advantageous as a treatment in selected cases. Treatment with drugs is rarely practical, except in special instances. Promiscuous drenching in this or any other disease is distinctly a bad practice.

Sick animals should be separated immediately from the rest of the flock and kept to themselves throughout the outbreak. The affected sheep particularly should be kept in clean, warm, well-ventilated quarters. Plenty of fresh water and a small quantity of clean, bright hay or succulent feed should be provided, without any concentrates or with only a light ration of grain, including some bran for its laxative effect.

#### JOHNE'S DISEASE (PARATUBERCULOSIS)

This disease, so named after one of its early investigators, occurs most commonly in cattle but sometimes affects sheep and goats.

**SYMPTOMS.**—The chief feature of the disease is a chronic inflammation of the intestines caused by the germ *Mycobacterium paratuberculosis*. Marked emaciation and a profuse diarrhea suggestive of severe parasitism are common. The disease often results fatally in a few weeks or months.

When examined post mortem, the walls of the small and sometimes of the large intestines are usually seen to be much thickened. The surface of the bowel is coated with abnormally large amounts of mucus, beneath which hemorrhages may be found. The lymph nodes of the intestines are usually swollen.

Diagnosis is based usually on tests applied with johnin, a product prepared from the growth of *Mycobacterium paratuberculosis*, in about the same way as tuberculin for the diagnosis of tuberculosis is produced from the growth of *M. tuberculosis*. By laboratory methods the germs of the disease may be detected in the bowel contents or scrapings of the bowel wall.

**PREVENTION.**—There is no known specific remedy for the disease, and slaughter under veterinary supervision is recommended. Animals showing symptoms suggestive of this disease should be promptly isolated pending determination of the cause. Periodic testing with johnin and repeated cleaning and disinfection are advisable if the disease is to be eradicated from a given flock or band.

It is believed that sheep with John's disease may infect cattle, and vice versa, so that the two species should be housed and pastured separately in case the disease appears in either. Actually, however, this is but one of many reasons for not allowing the two species to run together.

## LISTERIOSIS (LISTERELLOSIS)

This is a recently recognized infectious disease that has been identified in this country not only in sheep and goats but also in chickens, rabbits, cattle, swine, and man. It is caused by the germ called *Listeria monocytogenes* (*Listerella monocytogenes*). Typically, the germ causes an encephalitis, or inflammation of the brain, but it may also be responsible for abortions. It is to be differentiated from encephalitis due to other causes (see page 33), as well as rabies, enterotoxemia, pregnancy disease, milk fever, and so-called gid.

**SYMPTOMS.**—Among the first indications are fever, dullness, inflammation of the eyes, and strange, awkward movements. Signs sometimes suggesting lameness but actually due to brain disturbances soon develop. There may be staggering and pushing of the head into objects and walking in circles. The animal loses appetite and finally ceases to eat. Paralysis follows, finally resulting in death. In some flocks, losses have been as high as 10 percent. Early in the outbreak practically every sheep affected dies. Later some animals may recover.

Post mortem examination does not suffice for diagnosis. The disease is definitely diagnosed by laboratory examinations, including microscopic study and isolation of the causative organism.

How the infection is contracted or spread is not yet known definitely. There is no method of treatment known to be efficacious, nor have effective means of prevention been developed.

## MASTITIS (MAMMITIS, GARGET)

Mastitis is a term applied to inflammation of the udder. When it occurs in a goat dairy it may become an especially troublesome disease, rendering the milk unsuitable for human consumption. In ewes the disease commonly assumes the form referred to as "blue bag." Here, as a result of the severe inflammation and infiltration, the udder becomes dark or bluish in color. The inflammation and impaired circulation in the part may finally result in actual gangrene or death of the tissue or even the animal itself.

**CAUSE.**—The essential cause of the disease, whether in milking does or in ewes, is infection. In the case of the doe, staphylococci and streptococci are commonly found. In ewes, both of these organisms as well as *Corynebacterium pyogenes*, "coliform" organisms, and some that are similar to *Pasteurella* have been identified. In either does or ewes *Corynebacterium ovis*, the cause of caseous lymphadenitis, may localize in the udder, producing abscesses which may either impair or destroy the function of the gland.

**SYMPTOMS.**—Ewes especially are apt to develop fever accompanying much pain and swelling of the udder. Early, there may be little change in the secretion of the gland, but often later only a small quantity of yellowish or reddish fluid is present. The udder becomes very tense and hard, and, if gangrene intervenes, cold to the touch. Early in the disease the ewes resent nursing by the lambs and finally refuse to permit them to suckle. In very severe cases death may occur in 48 hours, following septicemia, or so-called blood poisoning. In other types of infection, abscesses form in the udder. Whatever the developments, unless checked, the disease invariably results in destruction or impairment of at least half the udder, ren-

dering the ewes so affected very undesirable if not entirely unsuitable animals for breeding.

Mastitis becomes a particularly disturbing trouble in goat dairies where it may spread among the milking does much as does mastitis of cattle, though the type of infection is different. There are fever and depression, and the appetite may be lost. The udder of the affected animal becomes hot and painful, and such little milk as is yielded frequently has a curdled or flaky appearance and is, of course, unsuitable for human consumption. Death from the disease is much less frequent than is the case with ewes, but, as with the latter, there is danger of permanent damage to the udder.

**PREVENTION AND TREATMENT.**—In general, the more milk secreted by the animal the greater is the likelihood of udder trouble. A ewe that produces a large amount of milk sometimes secretes more than her offspring will consume. The excess secretion tends to reduce the resistance of the gland to bruises, cold, and infection. Such animals require special attention to see that they are milked out, either by nursing an orphan lamb on the excess milk or by hand milking. In addition, the amount of milk may be somewhat reduced by decreasing the feed, particularly the grain or other concentrate.

The same general principle applies in milk goats, though with these animals, of course, the object is usually to obtain as great a flow of milk as possible. The milker is, therefore, responsible for completely milking out the udder at each milking and adjusting the interval between milkings according to the amount of milk yielded. In most instances, two milkings a day, which should be spaced at regular intervals, will suffice, but some animals should be milked three or even four times a day. It is a good practice to brush the animals, and especially the udders, free of loose hair and foreign material, always thoroughly washing the hands before beginning to milk. Some operators regularly wash each udder with a clean cloth moistened in boiled water or a chlorine solution, such as is commonly used in cow dairies. The udder should then be thoroughly dried with a clean cloth.

Undue exposure to cold, especially in rainy or snowy weather, should be prevented with either milking does or nursing ewes. Cleanliness should be stressed in the shelters provided for the animals. Accumulations of manure and soiled bedding should be removed frequently, and dry, clean bedding should be provided regularly. Ordinarily, the sooner ewes with lambs at their side can be turned out into pasture or on the range the better, not only from the standpoint of mastitis but other troubles as well.

At the earliest sign of udder trouble the affected animal should be promptly removed from the flock to separate quarters. The ration should be reduced, particularly the concentrates, and the animal fed principally on succulent feed, such as silage, roots, and freshly cut forage. Clean bright hay, preferably alfalfa, clover, or other legume may be fed.

The young should be allowed to nurse at frequent intervals or the udder should be milked out every few hours, avoiding unnecessary roughness as much as possible. The milk of either ewe or doe should be destroyed to prevent the spread of infection. Separate utensils should be used for milking animals with mastitis and they should be

frequently cleaned and sterilized. The animal may be given a saline purgative. If little or no milk is secreted, the lamb should be removed from its mother and either placed with a ewe that has lost her lamb or else be fed from a bottle. The udder may be bathed every two hours with boiled water, either alone or with a mild antiseptic added, at a temperature which can just be borne by the hand. Internal medication may be prescribed by the veterinarian.

In cases of abscess formation it may become necessary to lance the tissue to permit escape of pus. If gangrene develops, it may be necessary to amputate the udder. If there is any doubt as to the soundness of the udder in animals that recover from the acute disease, they should be fattened for slaughter under inspection.

In cases where specific infection is suspected, samples may be taken for bacteriological examination. In some instances, bacterins or other biological products prepared from the causative organisms have been reported as being successfully used in preventing spread of the disease and in treatment. In cases where the type of infection is known, one of the sulfa drugs may be applicable.

#### METRITIS (INFLAMMATION OF THE UTERUS)

This ailment is included among the infectious diseases because it is invariably due to infection of one type or another, and frequently occurs as a veritable enzootic, especially in ewes.

Metritis almost invariably precedes or follows abortion and it also is a common sequel in cases of difficult labor, then being induced by unclean practices during the process of assisting in delivery of the young. Once such an infection, sometimes referred to as septic metritis, becomes established in a band of lambing ewes, it may spread from one animal to another without the direct intervention of the operator, even occurring after normal lambing.

**SYMPTOMS.**—Metritis may be evidenced by retention of the afterbirth, excessive or abnormal discharge from the genital passages, more or less fever, straining and occasional eversion or prolapse of the vagina, or even the uterus. In the enzootic form, high fever, marked prostration, cessation of the milk flow, extreme stupor, and other general indications of so-called blood poisoning occur. In such cases the disease is commonly fatal.

**PREVENTION.**—Elimination of infectious abortion and meticulous cleanliness in the lambing quarters constitute the basis for prevention of metritis.

**TREATMENT.**—Aside from moderate feeding with mildly laxative feeds, supplying warm, clean shelter, and plenty of fresh water, there is little that can be done without the services of a veterinarian. No one else should attempt to flush the uterus or douche the vagina with antiseptic solution or attempt similar treatment. Affected animals should be isolated where they can be given individual attention, separate from other parturient animals.

#### NECROBACILLOSIS

This disease arises from the invasion of the body by *Actinomyces necrophorus*, known commonly as the necrosis bacillus through its necrotizing or death-producing action on the tissues.

As previously described, the germ causes complications in sore mouth and plays a role in foot rot. Two other conditions attributed to the complications of necrobacillosis are (1) a form of venereal disease which affects the sheath and penis of the ram and the vulva of the ewe, and (2) liver necrosis in young lambs. The venereal lesions are believed, as a result of recent investigations, to arise primarily through the action of a filtrable virus.

In liver necrosis the infection gains entrance to the body through the freshly ruptured navel cord at birth. The organism causes no outwardly apparent damage to lambs until they are from 1 to 3 weeks old. They sicken and die in a day or two, and at post mortem examination the liver is usually found to contain grayish abscesslike areas of necrosis of various sizes throughout the organ.

Necrobacillosis is essentially a disease associated with old, filth-laden barns, sheds, and corrals, especially on premises long used by livestock. The organism apparently survives for long periods in the soil, remaining capable of inducing infection.

Treatment of necrobacillosis is not practicable unless the extent and location of the infection are such that local antiseptics may be applied. Such cases would include venereal infection of rams, or ewes, a condition that usually responds to treatment with mild antiseptics. There is no treatment that is known to be effective for liver necrosis of lambs but this malady may be prevented to a large extent by the application of tincture of iodine to the freshly ruptured navel cord, as described under the subject of arthritis.

#### PINK EYE (INFECTIOUS KERATITIS, CONJUNCTIVITIS)

This disease sometimes makes its appearance in flocks of sheep and spreads rapidly, as it does in cattle, until practically every animal has sore eyes in one form or another.

CAUSE.—Pink eye is infectious and can be transmitted readily from one animal to another artificially. The exact nature of the primary cause, has, however, not yet been determined. Thus, it may be a filtrable virus, rickettsia, a bacterium, or a combination of these.

Sheep appear to be particularly susceptible to eye troubles, some of which may simulate the infectious disease, pink eye. Among these are entropion, or inversion of the eyelids so that the lashes brush the eyeball, wool blindness which is common in certain breeds and strains owing to the growth of wool over the eye, avitaminosis, or lack of certain vitamins, particularly vitamin A, and inflammations induced by the presence of dust particles or other foreign bodies in the eye. As has been stated, disturbances of the eyes may occur in listerellosis and may complicate sore mouth. Parasites (*Thelazia californiensis*) may be responsible for eye troubles in isolated instances.

TREATMENT.—The first step in handling eye troubles, whatever their cause, is to isolate the affected animal, preferably in darkened quarters. If entropion is responsible, a common procedure is to suture the offending eyelid back. Wool blindness is, of course, remedied by clipping the wool about the eyes. Foreign particles are removed. If the eye condition is concluded to be due to lack of vitamin A, changes in the ration should be made or some substance supplied that will satisfy the deficiency.



In case of pink eye, or infectious keratitis, spread may be forestalled by immediate separation of the affected animals from the band. Darkened quarters rest the eyes and aid recovery. Mild antiseptic solutions such as 4 percent boric acid solution or 10 percent argyrol may be used to flush the eyes two or three times a day. If complications such as ulcers, or opacities develop, special attention is required.

#### POX (VARIOLA)

Clinically, this disease in sheep and goats may closely resemble so-called sore mouth, which according to general belief among investigators is distinct from true pox and hence not to be confused with it.

The pock diseases are more or less common all over the world, affecting man (smallpox), sheep (sheep pox), goats (goat pox), cattle (cowpox), swine (hog pox), and horses (horsepox). All are similar diseases, though there are variations in the types of filtrable virus responsible in the several species affected.

Fortunately, neither goat pox nor sheep pox have ever become serious problems in this country. While comparatively a mild disease in goats, pox in sheep may cause heavy mortality.

#### RABIES

Rabies, commonly known as hydrophobia when it affects man, is fortunately not a common disease in the United States.

It persists, however, in certain areas where there are inadequate provisions for the control or elimination of stray dogs.<sup>7</sup> Coyotes, wolves, skunks, foxes, and other wild animals may contract rabies from dogs and cats, and perpetuate the disease in a given locality, with periodic flare-ups. At these times livestock, including sheep and goats, may contract the disease through the bites of infected animals.

**CAUSE.**—The disease is caused by a filtrable virus, which is present in the saliva of affected animals and which affects the brain primarily. Rabid dogs or wild carnivores usually become aggressive at some time during the course of the disease and attack any moving object in the path of their wanderings. Thus livestock and man acquire the disease.

For various reasons, a few animals bitten by a rabid creature escape the disease, but once it develops death is inevitable, as there is no effective cure after typical symptoms appear. The time which ensues between the bite and first symptoms is usually from 2 to 8 weeks but may be as short as one week or even as long as 2 years.

**SYMPTOMS.**—Sheep and goats present symptoms similar to those seen in other rabid animals.<sup>8</sup> The affected animals frequently lick and gnaw at the site where they were bitten or, if they cannot reach the spot, stamp their feet and bleat. They may show signs of frenzy and run to and fro. Although naturally shy animals, they may become belligerent and attack other animals, even including dogs, by butting and biting. There is usually some drooling of saliva. This is indicative of throat paralysis, which when well developed prevents

<sup>7</sup> For further information see Farmers' Bulletin 1268, Sheep-Killing Dogs.

<sup>8</sup> For further information see Farmers' Bulletin 449, Rabies or Hydrophobia.

eating and drinking. Abnormal sexual excitement sometimes occurs. The disease usually lasts only a few days, but may extend up to 8 days. The end comes after the animal goes down from paralysis.

**PREVENTION.**—From a practical standpoint, the control and eradication of rabies depend chiefly upon controlling the movements of dogs, especially strays and ownerless animals. To achieve this, licensing and patrol by conscientious authorities are necessary. As an adjunct, various forms of rabies vaccination are practiced.

Animals known to have been bitten by a rabid animal should be destroyed or at least isolated for observation. In case of an especially valuable animal, repeated injections of rabies vaccine may be given to forestall the disease. When once the symptoms of rabies become well developed, the case is hopeless. Suspected cases of rabies should be reported immediately to the local practicing veterinarian, State livestock sanitary authorities, or local public health agency, in order that proper steps may be taken to identify the disease and prevent its spread.

When conclusive proof of the nature of the disease is desired in suspicious cases, it is preferable to allow progress of the disease to death, after which the so-called Negri bodies of rabies are usually microscopically demonstrable in the brain. If the animals are killed during the course of the disease, Negri bodies may not be found. Laboratory animals also may be inoculated to confirm the diagnosis.

#### SEPTICEMIA AND PYEMIA

These conditions, commonly referred to as blood poisoning, consist of infections of the blood stream with disease germs or pus-forming micro-organisms.

Blood poisoning is a common development in many diseases, occurring to a greater or lesser degree in anthrax, hemorrhagic septicemia, lamb dysentery, abortion, arthritis, mastitis, navel infection, and in many cases of wound infection.

The seriousness of the condition depends largely upon the type or types of germ present. The gravity of the disease in the case of anthrax is readily apparent. But other germs as well may cause death through their circulation in the blood stream.

**CAUSE.**—A common cause of pyemia in sheep in some localities is the presence of barbed awns of grasses, the spiral process of alfilaria, and other penetrating substances in the feed or bedding. These objects penetrate the skin, become lodged under it or even enter the body cavities. With them go myriads of many kinds of germs. These incite the formation of numerous abscesses of various size at many places in the body. Inflammation of the lining of the abdominal cavity, peritonitis, may result if the foreign bodies penetrate into the cavity. Abscesses may develop in the liver, kidneys, and elsewhere. Stiffness, fever, loss of appetite, and progressive weakness, commonly leading to death, occur. Another cause of peritonitis and pyemia is the rupture of the abscesses in the intestinal wall produced by nodular worms (*Oesophagostomum columbianum*).

**PREVENTION.**—Obviously, avoiding the specific diseases of which septicemia or pyemia may be a part prevents the occurrence of these conditions. Prevention of infection of accidental or operative wounds

and of the navel cord at birth forestalls the development of the diseases from these sources. Avoiding feed containing undesirable foreign materials, such as those mentioned, prevents losses from these causes.

**TREATMENT.**—Depending upon the nature of the infective agent, treatment may be practical in some cases. For the most part, however, prevention is to be stressed.

#### TETANUS (LOCKJAW)

As tetanus usually results from wound infection it is discussed under that heading on page 58.

#### TUBERCULOSIS

This disease may affect all kinds of livestock, sometimes affects dogs and cats, has been found in numerous species of wild animals, and is common in man, having been known from very early times. Until recent years it was a very common disease in cattle, especially in some sections of the country, but as a result of eradication measures it is today comparatively an infrequent disease in that species.<sup>9</sup> Hogs and chickens are more frequently affected, particularly in certain sections. Tuberculosis is not widespread in sheep and goats but occurs chiefly in individual flocks where there is contact with tuberculous fowls or cattle.

**CAUSE.**—Tuberculosis is caused by *Mycobacterium tuberculosis*, a germ with characteristic staining and other qualities by which it may be identified in the laboratory. There are three main varieties of the organism: (1) The bovine type which affects cattle primarily, (2) the avian type which affects primarily chickens, other avian hosts, and swine, (3) the human type. Any of these may affect sheep and goats. Tuberculosis in sheep, however, is usually due to the avian organism, and goats are more often affected by the bovine strain.

**SYMPTOMS.**—Tuberculosis, being a chronic disease, may progress for many months or even years without causing serious trouble, and some animals may die from other causes in the meantime, never succumbing to the tubercle bacillus. This is particularly true in sheep.

Tuberculosis in sheep is so rare and benign a disease that it may be overlooked, even at post mortem examination, partly because of confusion with the lesions of other diseases, especially caseous lymphadenitis and parasitic lesions. The lesions, consisting of grayish-yellow, gritty foci in the lymph nodes of the intestines, and more rarely other organs, are most often encountered in slaughter sheep which have been reared in more or less close contact with tuberculous poultry.<sup>10</sup>

The disease is seldom encountered in range goats but has been found in severe form in a few goat dairies. Its presence in goats renders the raw milk from the dairy unfit for human use, the degree of danger depending somewhat upon the extent and location of the lesions and the type of infection. When chronic mammary troubles are encountered in goats, tuberculosis is one of the diseases to be considered. Depending upon the location and extent of the disease process, emaciation, cough, excessive or bloody nasal discharge,

<sup>9</sup> See Farmers' Bulletin 1069, Tuberculosis in Live Stock.

<sup>10</sup> See Farmers' Bulletin 1652, Diseases and Parasites of Poultry; Leaflet 102, Eradicating Tuberculosis from Poultry and Swine.

chronic bloating, diarrhea, body gland enlargements, or nodular abscesses in the udder may be observed. On post mortem examination, tuberculosis of the lungs, with extensive cavitation and foci of grayish cheeselike or gritty pus are sometimes seen. The disease may be generalized in the animal or it may be so mild as to render diagnosis difficult, if not impossible, except by technical means.

Diagnosis of the disease in the living animal may be accomplished through the application of the tuberculin tests by a veterinarian, as in cattle. In mild cases this may be the only means of diagnosis. Confirmation of diagnosis in advanced cases may be achieved by bacteriologic examination of discharges or tissue removed either before or after death.

**PREVENTION.**—Regular testing of all animals in goat dairies should be carried out, just as is the case in cow dairies. The reacting animals should likewise be slaughtered under veterinary supervision. The premises should then be thoroughly cleaned and disinfected and retests applied at intervals.

Except in unusual and rare instances, the testing of range sheep or goats is not deemed to be a necessary or practical routine procedure. Bands or flocks in which the disease is known to be present or those known to have contacted tuberculous animals of other species should, however, be repeatedly tested and the reactors slaughtered until the disease is eradicated.

Sheep or goats, as well as other species of animals, do best when kept to themselves. This is especially desirable if tuberculosis or other transmissible disease is known to exist in the other animals.

#### TULAREMIA (RABBIT FEVER)

This is the disease that man contracts as a result of dressing or handling infected rabbit carcasses or through the bites of certain infected flies or ticks. Although so far as is known tularemia is a comparatively rare ailment in sheep, it has been encountered on several occasions in western range sheep.

**CAUSE.**—The cause of the infection is the germ *Pasteurella tularensis*. Tularemia is prevalent in wild rabbits and other rodents in wide areas of the country, and these animals appear to constitute the chief reservoir of the causative organism, although the disease has been identified in numerous other species in nature.

**SYMPTOMS.**—The disease appears during the early part of the tick season, late spring or early summer, shortly after turning the sheep on the range. The onset of tularemia is usually slow, the first abnormality noted being a stiff-legged walk. Usually there is a high fever, accompanied by rapid breathing. Scouring and extreme depression are common symptoms. Weakness increases until the animals are unable to stand, and death usually follows within a few hours to several days.

In the cases described, so-called Rocky Mountain spotted fever ticks, *Dermacentor andersoni*, were always found on the sick animals, and from the evidence available were concluded to have transmitted the disease. The removal of the ticks before or soon after the affected animals were down increased the likelihood of recovery, but in some instances the disease caused the death of as many as 10 percent of the animals in the bands.

Post mortem examination of sheep dying from the disease regularly revealed enlargement or congestion of the lymph nodes of the regions where the ticks were most commonly attached, such as about the base of the ears, the point of the shoulder, and the inside of the front legs. The pelts removed from the dead sheep sometimes showed reddish to purplish areas of hemorrhage underlying the sites of attachment of the ticks. Occasionally, ulceration of the tissues surrounding the point of attachment of the ticks was observed. There was no evidence of any relationship between this disease and so-called tick paralysis, which is discussed in the section on Miscellaneous Diseases.

**PREVENTION.**—Although no effective medicinal treatment for the disease has been developed, early removal of the ticks aids recovery. In view of their possible infection with either tularemia or Rocky Mountain spotted fever, the ticks should be handled with great care and should be promptly and completely destroyed, preferably by burning.

The band should be moved to tick-free or relatively lightly infested ranges, if this is practicable after the ticks on the animals have been removed.

Animals raised in an area where tularemia is prevalent are considered to be less susceptible to the disease than those from uninfected areas, probably because even a mild attack produces considerable immunity.

## MISCELLANEOUS DISEASES AND ABNORMAL CONDITIONS

### ABNORMAL MILK

The most common cause of abnormal goat milk is mastitis (p. 18). Instead of being of smooth, uniform consistency, the fluid is often flaky, stringy, watery, straw-colored, and sometimes bloody. Such abnormalities are best detected by means of a stripping cup. This consists of a small cup over which there is a fine-meshed screen, which collects clots and other material indicative of udder infections. The stripping cup should be a standard part of the equipment of every goat dairy.

Blood in the milk may arise from mastitis or it may come from a ruptured blood vessel. It may result from a blow on the udder or undue roughness in milking, and is sometimes seen in heavy-milking does for a few days just after freshening.

Bad odors or flavors in freshly drawn milk are due to bacterial infections (mastitis) or to feeds or medicines which are partially eliminated from the body through the milk. Milk that is normal when drawn from the udder may become bitter, ropy, slimy, or discolored through bacterial contamination derived from unclean milking methods or utensils. A metallic flavor sometimes develops in milk stored in certain kinds of metal containers.

Abnormalities of the milk caused by udder infection completely disappear only after the infection is eliminated. Blood usually disappears from the milk after a few days on reduced feed and careful milking, unless the cause is infection. Withholding feeds or medicines that taint the milk will eliminate these sources of trouble. However, it is possible to utilize some feeds which are objectionable for this reason, by feeding them after, rather than just before or during milking operations.

To eliminate objectionable changes in milk that result from bacterial growth after the milk is drawn from the udder, full consideration must be given to each successive step in the handling of the product. To begin with, the milking stable should be kept in a sanitary condition, and free from dust or odors which may be absorbed by the milk. Milking should be done in a cleanly manner, using thoroughly cleansed, or better, sterilized pails. The sooner milk is cooled after it is drawn, the better its quality generally. Also, it must be kept cool until used, if it is to long remain wholesome.

All milk receptacles should be well rinsed with clean, cool water immediately after use. They should then be scrubbed thoroughly, using a brush with stiff bristles, warm or hot water, and a good washing powder. If there are no facilities for sterilization, the utensils should then be rinsed with liberal quantities of boiling water, and stored in an inverted position on a clean, sheltered rack. Buckets which have broken or loose seams, or that are badly dented or rusty should be used for some purpose other than holding milk.

#### ANEMIA

Anemia consists in a deficiency of blood. As the term is commonly used, it applies to the condition wherein there are fewer than normal numbers of red blood cells or a decrease of the quantity of the pigment known as hemoglobin. A specific anemia of sheep and goats caused by a filtrable virus, has been identified in foreign countries, as has anemia due to *Babesia ovis*, a protozoan parasite, but neither disease is known to be present in this country. Pernicious anemia as it occurs in man is not known to exist in any of the lower animals.

American sheep and goats, especially lambs and kids, commonly suffer from anemia, but this is usually termed secondary, as it results from some primary disease or other abnormality. The most common cause is infestation with internal parasites, but various infectious diseases and some forms of intoxication may be responsible. Inadequate or improper feeding also may produce the condition, as may extreme hemorrhage. Deficiencies of iron, copper, and cobalt in the feed grown in certain areas sometimes cause a wasting disease, accompanied by anemia.

As a result of these several causes the red blood corpuscles may be reduced in number from the normal 8 to 10 million per cubic millimeter in sheep, and 10 to 18 million in goats, to only a fourth of those numbers. These cells contain coloring matter or iron-containing pigment (hemoglobin) and carry the oxygen acquired by the lungs from the air for the nourishment of the body tissues.

When the red cells are greatly reduced in number, the mucous membranes become very pale or chalk-white in appearance. But sometimes this is not readily apparent due to the presence of icterus, or jaundice, at the same time. Anemic animals are dull and become weak, both signs becoming more marked as the condition progresses. The slightest exertion causes abnormally increased respiration and pulse rate. Animals with such symptoms should be examined to determine whether anemia actually exists.

The nature of the trouble is detectable only through microscopic examination, cell counts, and other laboratory procedures. In the

average case, parasitism is first suspected if some other obvious cause is not apparent. Parasites should be eliminated if found to be present, as no animal can thrive if chronically anemic. If sufficient parasites are not found to account for the trouble other conditions should be considered, the remedy varying according to the nature of the cause.

#### BIGHEAD

Until recent years, the cause of bighead was unknown. As it is now known to be due to eating certain plants, the disease is discussed in the section on Poisons and Poisoning, under the heading of Photosensitizing Plants.

#### BONE CHEWING

Animals on feeds low in phosphorus commonly chew bones, wood, dried or decayed animal carcasses or other materials as an instinctive reaction to the dietary deficiency. Phosphorus deficiency commonly occurs on overgrazed land or during prolonged drought. Affected animals become unthrifty and reproduce poorly. Milk production falls to a minimum.

The remedy is improvement of the diet. Phosphorus-rich feeds, such as oil meals or cakes (cottonseed, linseed, or soybean), grains or mill feeds (bran, shorts) should be supplied. Mineral mixtures consisting of bonemeal and salt, or defluorinated phosphatic limestone and salt, may be given. General undernutrition, however, requires provision of other nutrients as well as phosphorus, especially protein.

#### BLOAT (HOVEN, TYMPANITES)

The excessive accumulation of gas formed during the fermentation of feeds in the stomach and intestines is commonly referred to as bloat. It is probably more common in cattle than in sheep, goats being even less often affected. But when the trouble develops in a large number of any of these, many animals may die.

**CAUSE.**—The commonest causes of bloating are the eating of excessive amounts of green feeds, especially alfalfa or clover, and the feeding of wet hay or any frozen feed. Wet and partially fermented grain may be responsible. On the other hand, an excessive amount of almost any feed, especially if it results in retarding normal digestion and elimination, may cause bloating. Bloat is a common sequel of choke. Finally, bloating occurs as a secondary condition in some diseases not directly involving the digestive organs.

Animals unused to green, succulent feeds are inclined to gorge when allowed free access to them and the usual consequence is bloating. However, in some sections of the country where the humidity is low, such crops as alfalfa, clover, soybeans, and rape are commonly used for pasture with little danger. But in sections where such forage frequently gets wet from dew or rain, special care must be used in pasturing it.

Young, nursing animals which regularly obtain milk appear to be relatively safe from bloat. Older animals seem less likely to bloat if allowed a good fill of dry hay, straw, or even bluegrass before being turned into lush pastures of legumes. According to recent investigations the benefit of these preliminary feeds is derived from the relatively large amount of fiber in them.

**PREVENTION.**—The first principle to observe when trying to avoid bloating is to allow sound feeds only. None that are wet from dew, rain, or snow should be allowed, except under necessity, and then caution should be exercised. Frozen feeds, especially if green, should be avoided. Any new feed, particularly if it is especially palatable, should be allowed only in small quantities. Using care and judgment, the quantity of such feed may be gradually increased and finally free access may be permissible. When pasturing or feeding animals on new feeds they should be closely watched in order to detect the first signs of trouble. Preliminary to pasturing on green legumes, the feeding of a dry, fibrous roughage helps to prevent bloat.

**SYMPTOMS.**—In most cases, the gases accumulate especially in the rumen, or paunch. This results in the distention of the left side of the abdomen chiefly. The skin may become very tightly stretched and when tapped with the hand a hollow, drumlike sound results. The animals stand helplessly, with a distressed appearance and breathe shallowly and rapidly, often with the tongue hanging from the mouth. In severe cases the animal gradually becomes more and more distressed, staggers, and finally falls to the ground, dying in convulsions. Death results either from suffocation or the absorption of the poisonous gases.

**TREATMENT.**—There are perhaps more so-called sure cures advocated for bloat than for any other ailment. Many such preparations and procedures are worthless or even harmful.

A veterinarian, if available, should be called to the premises immediately. Pending his arrival such animals as are still active and eating should be removed immediately from the field or pen where the trouble develops. But even before this, it may be necessary to attend to the animals that are down and threatened with death.

In some cases escape of the gas may be effected by placing the animals so as to elevate the head, with the hind parts lowered. A bit made of a piece of broomstick or other piece of wood about  $\frac{3}{4}$  inch in diameter may be placed in the mouth and drawn well back by a rope or string fastened over the poll or back of the ears from one side of the mouth to the other. Gentle kneading of the animal's sides may promote escape of some of the gas. Rough handling, excitement or forced drenching of a seriously affected animal may result in sudden death. Some cases may require tapping of the paunch, with a trocar and cannula to permit escape of the accumulated gas but except in emergencies this and medicinal treatment should be left to the veterinarian.

In isolated sections where a veterinarian is not readily available it is a good plan to guard against the possibility of bloat by obtaining instruction and the necessary equipment for first aid or emergency treatment from a veterinarian familiar with local conditions. Bloat can be largely if not entirely avoided by proper preventive measures.

#### CALCULI (GRAVEL IN THE BLADDER)

A calculus is a stonelike concretion which develops in a body cavity. In sheep being fattened for the market, what is commonly known as gravel is of more or less frequent occurrence, but the condition may develop in animals under other conditions. Urinary calculi are especially troublesome in bucks and wethers, due to their anatomical makeup.



**CAUSE.**—Much investigational work has been done to determine the cause of calculi which form in the urinary apparatus. Water containing high concentrations of certain mineral salts may be responsible. Mangels and sugar beets, as well as sugar beet tops and beet pulp, have been implicated in many instances. The feeding of a large quantity of such feeds as cottonseed or linseed meal, wheat bran, and other feeds containing relatively large quantities of phosphates may produce the condition. Experiments have shown that lack of vitamin A may result in the formation of calculi.

**SYMPTOMS.**—The presence of a small quantity of fine particles of so-called gravel in the urinary tract may cause no trouble. But in those cases in which the substance accumulates to such an extent as to cause partial or complete stoppage of the flow of urine, signs of sickness appear.

Usually the first symptom is uneasiness. Later, the animal becomes quiet but there are frequent periods of straining in an effort to void the urine. Urine may dribble from the sheath and salts may accumulate in the wool around the opening. Swelling, due to infiltration of watery fluids may be present around the sheath. Similar accumulations of fluid may be present in the abdomen, a condition known as dropsy and commonly called water belly. The continued retention of the urine or rupture of the bladder results in uremia (circulation in the blood of substances normally excreted in the urine).

**TREATMENT.**—This is often unsuccessful and generally the more economical course is to destroy seriously affected animals. In flocks where large numbers of the animals are affected, but still not severely, the entire lot may be sent to slaughter before the condition assumes serious proportions. A change of feed frequently results in benefit. The addition of yellow corn or alfalfa to the diet is also advisable. A change of water supply or the provision of a more ready access to that already in use may be recommended.

In some individual cases the stoppage of urine may occur in the penis and the accumulated concretions may be removed by careful manipulations with the catheter or by amputating the wormlike appendage at the end of the penis. Surgical removal of calculi may be practical in cases that merit the expense. When the exact nature of the salts in the calculi is known, chemicals may be given for aiding in their removal by solution.

#### CHOKER

Choking in animals refers to the lodging of feed or other material in the air passages or the gullet, usually the latter.

**CAUSE.**—The offending material is usually some such object as a piece of root, apple, potato or other improperly masticated feed.

**SYMPTOMS.**—Saliva usually drools from the mouth and there are frequent attempts at swallowing. The head may be thrust forward or extended toward the ground. Bloat commonly develops. If the substance causing the trouble is in the region of the neck it can usually be felt from the outside. Otherwise it may be detected only by close examination of the mouth and throat or the passage of instruments into the gullet.

**TREATMENT.**—With a speculum, by means of which the mouth is held open, the offending object may be withdrawn by the fingers or

forceps. If the object is in the region of the neck, it may be worked up along the gullet by gentle manipulation. Drugs may be given to promote expulsion of the object. In rare cases surgical procedures may be advised by the veterinarian. In extreme cases, emergency slaughter may be considered. Some value may thus be salvaged if the trouble is not too far advanced and if the meat is still considered by the veterinarian as acceptable for food.

#### **CRYPTORCHIDISM (RETAINED TESTICLE, RIDGELING)**

The testicles of male goats and sheep normally descend into the inguinal canal or into the scrotum before or within a few days after birth. When one or both testicles are retained in the abdomen or the inguinal canal, the condition is known as cryptorchidism. Animals affected with cryptorchidism are known as ridgelings, or ridgels, and are generally sterile.

The occasional offspring of ridgelings are in most cases like their sire, i. e., with retained testicles and most of them are infertile. The abnormality therefore is heritable. Affected animals or their offspring should not be used for breeding, but should be castrated as soon as the defect is discovered. According to some authorities, the abnormality is more common in goats than sheep.

#### **DYSTOCIA (DIFFICULT LAMBING OR KIDDING)**

The term dystocia is applied to any abnormality or condition which renders parturition, or birth of the young, impossible or unduly difficult and prolonged without aid. It may arise either through fault of the dam (maternal dystocia) or of the young (fetal dystocia).

**CAUSE.**—Infection of the uterus is a common cause, but generalized disease, malnutrition or weakness from any cause may be responsible. In the absence of disease, it is frequently encountered in young ewes and does in their first pregnancy, particularly if they have not been allowed sufficient development before breeding. It commonly occurs in closely confined and undernourished animals.

**PREVENTION.**—In too many instances, lambing or kidding troubles are increased by improper management. Much can be done to lessen these difficulties by observing the following principles:

Only healthy, strong, thrifty, and well-developed animals should be used for breeding.

Good condition, but not excessive fatness, should be maintained during pregnancy.

The breeding period may be shortened for each group of ewes, so that as many of the lambs as possible will arrive within a reasonable period. This is especially desirable under range conditions. In goat dairies, however, the primary object is usually to space matings so that as steady a supply of milk as possible will be obtained through the year from the flock. As far as possible the does are bred for both spring and fall kidding.

Pregnant females should be kept separate from other animals, allowing adequate but not too fattening feed, plenty of exercise, and ready access to clean water and shelter. They should be observed frequently to note their condition.

The females nearest parturition should be separated in one group, where they can be more closely and frequently observed than the other pregnant animals.

In some localities, under favorable weather conditions, lambing or kidding on the open range may be permissible or even preferable. But usually shelter must be provided. On large ranches in the West, this usually consists of a large, well-ventilated, but not drafty building, which previously has been thoroughly cleaned and disinfected, and is dry and well drained. Sectional panels, with which maternity pens about 4 feet square can be arranged in rows in the most sheltered portion of the building, are usually provided. Just before or just after parturition the mother is placed in this pen where she can be given individual attention. Here, an experienced and attentive shepherd or herder is very desirable.

**TREATMENT.**—The approach of parturition leads to a relaxation and a sinking-in of the flanks and the rump at each side of the spine. Later, the ewe (or doe) usually becomes uneasy and paces about considerably, or turns around frequently. Delivery of the young then proceeds rapidly if the mother is in good condition and the fetus is in proper position, which is with the fore feet first, and the head extended along the legs. But if the lamb or kid is abnormally formed or disproportionally large, or if the head or one or both legs are turned back, or parts of the bodies of twins enter the genital passage together, difficulty ensues.

During the first stages of labor, the mother should not be disturbed, but if developments do not proceed within the normal intermission of labor pains, she should be examined to determine the cause of difficulty. Obviously, the person fitted to do this is a veterinarian, but to have one on hand throughout the lambing or kidding season on the range is impractical, if not impossible, in many instances. The task of handling such cases falls too often to someone with no conception of the need for strict cleanliness. Large establishments may avoid this handicap by retaining a veterinarian to supervise all their operations. Others may obtain for their herders elementary instruction from their veterinarian, which is most desirable if lambing is to be carried out at a time and in a place where constant attendance by the veterinarian, or even emergency access to such service, may not be available when needed.

Many herders become very adept through experience in assisting in cases of dystocia, though of course they are not equipped with either sufficient training or instruments to become experts. For those without access to veterinary service and with no training or experience, the following suggestions are offered as of primary importance. Further information should be sought from the nearest qualified veterinarian.

Cleanliness of the lambing or kidding quarters, the mother, the person of the operator and his implements is essential if metritis, loss of the mother through infection or injury, or injury or death of the young is to be avoided. When it becomes obvious that the ewe or doe needs assistance, tags of wool should be clipped off and the rear parts of the mother should be cleansed. The attendant's hands and arms should then be thoroughly scrubbed with a brush, mild soap, and warm water. The use of crude coal-tar disinfectants or strong disinfectant

dips as substitutes for scrubbing and general cleanliness is a bad practice. Veterinarians have individual choices of antiseptics to be used in obstetrics. The layman should restrict himself to the use of a mild but effective substance, such as an approved chlorine preparation or 2 percent compound cresol solution U. S. P. After the rear parts of the animal and the hands and arms of the operator have been washed and dried with clean cloths, or cotton, such a preparation may be used as added insurance against carrying infection into the genital tract. Liquid petrolatum containing 2 percent of phenol may be used as a lubricant if the hand is placed in the genital canal to effect delivery of the fetus.

Gentleness should be the first rule in all such cases. Often it is only necessary to push the fetus back into the uterus to straighten the legs or extend the head. The strong mother should then be able to expel the fetus alone, unless it is unusually large or she has been in labor for a long time. If it becomes necessary to pull on the fetus, force must not be exerted unless the lamb is coming normally. Then the pull should be gently exerted, downward as well as away from the mother. The placenta (afterbirth) normally comes away directly after delivery of the young. If it does not, it should not be forcefully extracted. Skill and experience are required in its removal. Antiseptics or other fluids should not be indiscriminately injected into the uterus.

If such simple treatment does not suffice to effect delivery of the lamb or kid, veterinary service is usually essential, where it was only preferable before. An excessively large, bloated, decomposed, or malformed fetus may require dissection to remove it. Or it may be necessary to perform a Caesarian section, through which the fetus is delivered from the womb through an incision in the abdominal wall. But, to be successful this must be done before the mother is gravely weakened or infection is present. When a veterinarian is available, he should be called as early as possible, as delay greatly lessens the likelihood of success, no matter how well qualified an operator he may be.

#### ENCEPHALITIS

The term encephalitis means inflammation of the brain. Both rabies and listeriosis are forms of encephalitis. Another is louping-ill, a specific filtrable virus disease that occurs in sheep in the British Isles, but has not been observed in the United States. Still other cases of encephalitis arise from infection with such bacteria as staphylococci, streptococci, and other pus-forming organisms.

Cause—Pus-forming bacteria may invade the body through the umbilical cord at birth, through the wounds of castration, docking, or ear-marking, or by way of accidental wounds. They may localize and cause no great harm, but once within the tissues they are likely to spread by way of the blood stream, reaching the joints, or internal organs, such as the brain, spinal cord, and meninges—the membranes covering the organs of the central nervous system. Encephalitis, myelitis, or meningitis then result.

SYMPTOMS.—For the purposes of this bulletin, it will be necessary only to point out that varying symptoms result from these conditions. In general, they vary from nervousness, wildness, and mania on the one hand to depression, stupor and unconsciousness on the other.

Affected animals often appear to be blind. They may walk in circles or push the head into fences and other obstacles. Staggering and stumbling are common. In the early stages fever is usually present. Later, when the animal frequently collapses and becomes paralyzed, the temperature is usually normal or subnormal. Most animals so affected die in a few days.

**PREVENTION AND TREATMENT.**—Treatment of encephalitis is generally ineffective. When the disease occurs, the first consideration is to determine the cause, that is, whether it is due to rabies, listeriosis, or bacterial infection, or whether the symptoms arise from enterotoxemia, pregnancy disease, milk fever, poisoning, or invasion of the brain by parasites. Having determined this, it is then possible in most instances to proceed with appropriate measures to prevent more of the trouble. The cause can in some cases be determined by post mortem examination, but usually laboratory tests are required also.

#### ENTEROTOXEMIA (OVEREATING, FEED-LOT APOPLEXY)

Enterotoxemia is due to substances known as toxins which are formed in the digestive tract. One form commonly occurs in sheep, especially lambs, undergoing feeding for fattening for the market. It has been widely referred to as "overeating" or "overfeeding" and is sometimes known as "feed-lot apoplexy." Losses from this cause have been stated by one competent authority to probably exceed those of all other troubles combined in feed lots. The condition may also be encountered in nursing lambs and kids as so-called milk colic.

**CAUSE.**—The primary cause in the case of feed-lot animals appears to be the consumption of more concentrated feed (corn, barley, peas, etc.) than the body can readily assimilate. The immediate cause is suspected as being a toxin formed by *Clostridium welchii* (*Cl. perfringens*), a germ which is widely distributed in the soil apparently throughout the world. When heavy feeding is practiced, the organisms already present in the normal intestine appear to produce unusually large quantities of this poison, causing the death of many of the fattest and most vigorous animals in the lot and the loss of condition in many others. So-called milk colic appears in nursing lambs and kids on pasture as an acute fatal disease, apparently due to the same toxin.

**SYMPTOMS.**—The development of the malady may be so rapid that an animal dies suddenly after staggering and falling to the ground. Usually, however, the lambs live for several hours after staggering about the pen, with the head carried high (fig. 5). Some animals rush about the pen, blindly running into fences or travelling in circles. Convulsions are common. In acute cases there is commonly a stoppage of the bowels known as "stasis," but some animals which live longer, develop a diarrhea, stop eating, and vomit. A few of the animals may live for weeks, eventually recovering in a thin, weak state, afterwards to become very poor feeders.

On post mortem examination, inflammation is usually evident in the small intestines near the stomach or in the fourth stomach itself. In many acute cases numerous large hemorrhages are found in the abdominal cavity, notably on the diaphragm and along the intestines. Smaller hemorrhages may be found in and on the heart. A straw-colored fluid, often coagulated or jellylike, is usually present in the

abdominal cavity. Some animals which die suddenly are found to be essentially normal upon post mortem examination. However, several hours after death the liver may become very friable and the kidneys become "mushy" or "pulpy."

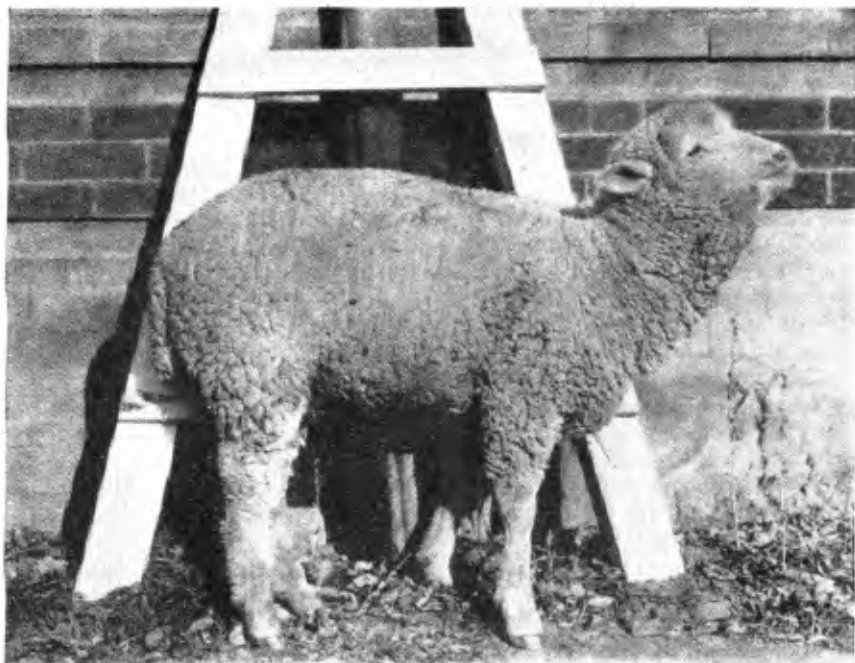


FIGURE 5.—Lamb showing effects of "overeating."

**PREVENTION.**—The object of feeding animals for slaughter is to bring them to the desired weight and degree of finish in as short a time as possible. The practice of feeding lambs especially is one which demands skill and judgment, the required degree of which the average feeder acquires only through experience. The problem begins with the lambs themselves, which are usually just recently weaned and are not accustomed to any feeds other than milk and grass. Patience and judgment are therefore required in adapting the animals to the new kind of feed and regulating the quantity fed.

A good practice is to feed nothing but hay or to pasture the animals for the first few days after arrival where the feeding is to be done. It may be 10 days before any grain feeding is desirable and then only a small part of the quantity finally fed during the finishing period should be allowed. During these first days the lambs become accustomed to their quarters, their feeder, and their ration. Undue haste in placing them on full feed will invariably prove disastrous, and the experienced feeder will gradually increase the ration according to the condition of each lot of animals. This procedure not only prevents deaths from overeating but also avoids digestive disturbances which may throw the entire lot more or less "off feed" for a variable time with consequent loss to the owner.

The practice of "lambling down" corn and other grains by turning the lambs into unharvested fields has been largely discontinued be-

cause the losses from overeating have been too heavy for profit. The common practice is to distribute the grain evenly in clean, shallow troughs, allowing all lambs access to the feed at regular daily feeding periods and providing equal space and opportunity for each animal. Free access is usually allowed to racks of clean hay. The lambs should be separated into groups containing lambs of nearly equal size and condition and fed accordingly. Each group of animals is an individual problem. Some lots are unable to consume more than a comparatively light feed without developing digestive disorders while others thrive on abnormally heavy feedings.

Frequent and regular observation will aid the experienced feeder in regulating feed. If a number of lambs are observed to go to the trough slowly or not at all, the allotment should be reduced immediately. If scouring develops, this indicates that the animals are getting more feed than they can handle properly at that stage in the feeding program. If these danger signals are ignored, the entire group may either be thrown "off feed" so that finishing to prime condition is usually difficult if not impossible, or enterotoxemia may follow with considerable death loss.

Flocks in which the condition known as "milk colic" develops may be moved to sparse pasture. If this is not feasible, the daily grazing period may be restricted and the lambs penned in a dry lot between grazing periods. This may prevent progress of the disease in the flock. In special cases, the antitoxin of *Clostridium perfringens* may be tried.

**TREATMENT.**—There is no satisfactory treatment. Acutely affected animals may recover, if removed immediately from the feeding pens and given a purgative and supportive medication. However, those that survive such an upset almost always remain poor feeders and practically never yield a profit.

#### FAINTING GOATS

Some individuals of certain strains of common, or American, goats are affected with a nervous instability which causes transitory collapse and spasms. When frightened or suddenly aroused by unfamiliar or abrupt sounds, the animals stiffen and frequently fall over on their sides, with the muscles tensed.

Usually the attack lasts less than a minute. The affected animal dazedly gets to its feet and walks stiffly for a short time, then becomes from all appearances entirely normal. Another paroxysm usually cannot be induced until after the lapse of 20 or 30 minutes after recovery from the first attack.

These animals are commonly called fainting or nervous goats. The condition has been determined to be heritable. Therefore, affected animals should not be used for breeding.

#### GOITER (BIG NECK)

This condition consists in an enlargement of the thyroid glands which are situated on each side of the windpipe near its upper extremity. The essential function of these glands is the secretion of a substance known as thyroxin which has to do with the regulation of body energy, and which contains large quantities of iodine. When the thyroid func-

tion is disturbed by an insufficient supply of iodine in the feed or water, goiter may develop. The disease is particularly prevalent in well-defined areas in the world where iodine deficiency is known to exist in the soil. Certain areas of the Northwest, the upper Mississippi valley and elsewhere in the United States are known to be deficient in iodine. In these sections goiter occurs as a congenital disease in kids, lambs, calves, foals, and pigs, but may develop in mature animals and man.

**SYMPTOMS.**—Lambs or kids are born with an enlarged neck or this condition develops soon after birth. The abnormality may be found in stillborn young or in weak, partially bald individuals that survive for only a few days. When swellings of the neck occur in older animals the condition may or may not be goitrous, sometimes being due to abscess formations of lymph nodes and not an affection of the thyroid gland.

**PREVENTION.**—Since treatment of affected animals is seldom practical, reliance should be placed on prevention. In sections where the disease is known to occur, iodine in one form or another should be fed to the pregnant ewes or does, during the entire gestation period. Either potassium iodide or sodium iodide may be given in the feed, with the salt, or in the drinking water. A very satisfactory way of providing iodine is in the form of iodized salt. Authorities generally agree as to the success of such medication in preventing so-called enzootic, congenital goiter. The usual proportion is 1 ounce of potassium iodide to 300 pounds of salt. Iodized salt may be purchased, already prepared, in block form. The product is entirely suitable, provided it is so compounded as to prevent disintegration of the iodine it contains.

#### HERMAPHRODISM

In this condition both male and female genital organs occur in the same animal. Either the external or the internal reproductive structures, or both, may be involved. Such individuals are termed bisexual animals. The term is also loosely applied to animals in which the sexual organs are so defectively formed as to make it difficult or impossible to determine the sex.

Bisexual animals are called hermaphrodites. Such creatures are not common in either sheep or goats, but probably occur more often among goats. In some flocks the condition has been observed to occur with such frequency from certain matings as to lead to suspicion that it is heritable. The discovery of hermaphrodites in a flock should lead to close scrutiny of the breeding records in order that undesirable parent animals may be eliminated.

#### ICTERUS (JAUNDICE, YELLOW)

This disease consists in a yellow or orange discoloration of the tissues, especially evident in the skin and mucous membranes, due to the circulation of bile pigments in the blood. It is a relatively common condition sometimes in combination with other symptoms such as depression and slow pulse, arising from a number of causes. Septicemic diseases which cause destruction of the red blood cells are commonly accompanied by jaundice. Catarrhal or other inflammations of the intestines resulting in partial or complete closure of the bile duct, which empties bile into the intestines from the liver, may be responsible. The



eating of certain plants or chemical poisons, or the presence of parasites that derange the normal functions of the liver or cause the formation of excessive connective tissue in the liver, is often responsible. Animals allowed free access to mineral and salt mixtures containing copper sulfate may develop copper poisoning. The symptoms include icterus and bloody urine. Death is common.

**TREATMENT.**—This depends on the cause in each case. Frequently the condition is not discovered until after the animal is slaughtered and many of these carcasses must be condemned as unfit for human food.

#### IMPACTION OF THE RUMEN (ATONY OF THE PAUNCH)

Overloading of the stomach probably occurs less frequently in sheep and goats than in cattle, but distention of the paunch by excessive quantities of dry or more or less indigestible material occurs occasionally. Contributing factors include excessive feeding, especially with dry, fibrous feeds such as straw, gorging on any feed to which the animals are unaccustomed, sudden changes of feed, inadequate or unsuitable water, and underlying febrile disease which impedes proper digestion.

**SYMPTOMS.**—The severity of the disease varies according to the underlying causes and the degree to which the animal is poisoned by the toxins resulting from decomposition of the accumulated feed. There is usually lack of appetite and dullness. The contents of the paunch are usually found to be doughy by pressing into the flank between the hip bone and the border of the ribs on the left side. This may cause flinching as an evidence of pain. The muscular contractions of the normal paunch are absent or much lessened in force and frequency. Most animals cease chewing the cud and some display grunting respiration and staggy walk or symptoms of colic, such as kicking at the belly. Vomiting may occur. There may be a moderate diarrhea or an obstinate constipation. Neglected cases commonly die as a result of autointoxication.

**TREATMENT.**—The feed suspected of causing the trouble should be removed immediately from the ration, or all feed should be withheld for a few days but ready access to a supply of clean water should be allowed. Kneading or massage of the paunch through the abdominal wall may be advantageous in stimulating contractions and assisting in movement of the packed mass of feed. Moderate exercise may be beneficial. The veterinarian may introduce a quantity of water into the stomach through a tube. Purgatives may be beneficial and drugs having a general stimulating or detoxifying effect are often useful. In some cases the paunch may be washed out by means of a stomach tube. Some animals require treatment should bloating occur.

Following the animal's recovery from acute impaction of the rumen, the feed should be of a laxative character and fed in small quantities until there is full restoration to normal digestion. Convalescence usually requires from several days to 2 weeks.

#### MILK FEVER (PARTURIENT, OR AFTER-LAMBING PARALYSIS)

This disease is familiar to everyone having experience with heavy producing dairy cows, but in ewes and does it is a comparatively rare disease. It is one of the so-called metabolic diseases, arising through

the complex processes by which feeds are transformed into animal tissue. A great many theories as to the exact cause of the ailment have been advanced and subsequently modified or discarded. Current scientific opinion is that the alarming symptoms occur because of insufficient calcium in the body, which arises from the nutritional demands of the fetus and possibly other factors. In ewes and does the disease is chiefly confined to heavy milking strains and animals which bear several young at a time.

**SYMPTOMS.**—The disease usually appears in 1 to 3 days following delivery of the young, though it may occur before the act or even a week later. There are loss of appetite, and restlessness or depression.

Contrary to the name, milk fever, little milk is secreted, and there is no fever in affected animals. Muscular weakness develops shortly, accompanied by stiffness and staggers gait, and finally collapse and unconsciousness. The animal seems to be in a deep sleep and is oblivious to noises or prodding. The breathing is deep and slow, sometimes attended by groaning. The body temperature, at first normal, sinks below normal in advanced cases. Proper treatment is usually followed by spectacular recovery. The disease may be confused with the much more common lambing paralysis, or pregnancy disease, which occurs before rather than after parturition.

**TREATMENT.**—As with affected cattle, treatment consists in injecting various preparations containing calcium either into the blood stream or under the skin, depending upon the compound used and the reaction desired. The inflation of the udder with air or oxygen, a method once practiced in cattle, has had only limited use in recent years as the calcium treatment is generally preferred by veterinarians. Drenching of animals affected with milk fever is particularly dangerous because of the impairment of ability to swallow. Medication is usually administered hypodermically.

#### ORCHITIS (INFLAMMATION OF THE TESTICLE)

An inflammation of the testicle invariably results in swelling and pain of the organ. The condition is most common in bands of bucks kept by themselves during the interbreeding season, when it arises from fighting or accidental injury. It sometimes occurs as a result of the venereal form of actinobacillosis or other infection, or excessive service.

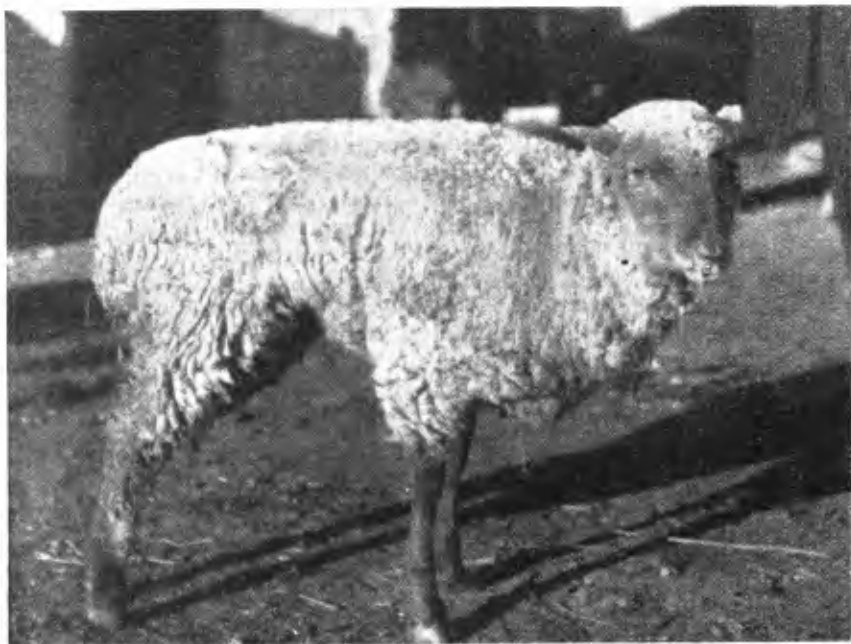
A severe condition involving infection of the testicles, penis, sheath, and even internal organs has been observed in closely confined overfed rams, which through lack of exercise and excessive feeding had developed abnormal sexual habits. Death occurred in some cases and the lamb crop resulting from service by the survivors was unusually small.

**TREATMENT.**—Treatment varies according to the extent of the inflammation. Extremely enlarged, abscessed or gangrenous testicles, or those in which hemorrhage has occurred, may be removed by castration, since many such animals never recover fertility. Acute pain and swelling may be remedied by application of a suspensory bandage containing cotton or other absorbent material which is soaked every few hours with a warm, saturated solution of Epsom salt or other medicant, or cold water may be applied. Laxatives, moderate feeding, and internal medication may be prescribed.

### PNEUMONIA

Pneumonia consists of an inflammation of the lungs. It may occur in the course of such infectious diseases as hemorrhagic septicemia, caseous lymphadenitis, as a result of lungworm infestations, or in the form of so-called **lunger disease** (chronic progressive pneumonia). It may result from drenching by inexperienced persons who allow the fluids to enter the lungs. A cause of pneumonia in range sheep is exposure during stormy weather following shearing. Recently-born, weak kids exposed to cold rain or snow are especially susceptible to pneumonia. Animals down for a considerable period from any cause may develop a type of pneumonia, known as hypostatic, so-called because of poor circulation and settling of the blood in the under side of the body.

**SYMPTOMS.**—These vary according to the nature of the cause and the extent to which the lungs are involved. There is more or less



**FIGURE 6.**—Sheep affected with chronic progressive pneumonia, also known as “lunger disease.”

difficulty in breathing, accompanied by nasal discharge, fever, cough, loss of appetite, and weakness (fig. 6). The death loss may be moderate or great.

**DIAGNOSIS.**—Recognition of the disease in the sick animal is not difficult for the trained observer. But exact determination of the immediate cause in each case may be more difficult.

Upon post mortem examination the lungs are found to be discolored and their consistency resembles that of liver. The lesions may involve one or both sides; they may be diffuse or largely localized. Changes in the other organs may be found also. Frequently a laboratory examination is necessary to determine the cause.

Chronic progressive pneumonia, or lung disease, usually occurs in mature sheep. It is evidenced by dense grayish areas in portions of the lung. In stained sections the tissues have somewhat the appearance of certain types of tumor.

**PREVENTION.**—Pneumonia due to specific infections can be prevented by the means discussed under the particular diseases themselves. Parasitic pneumonia may be prevented or controlled by isolation of affected animals, general sanitation, and pasture rotation, with consideration of the life cycle of the parasites involved.<sup>11</sup> Foreign-body pneumonia can be avoided by careful administration of medicines. When sheep or goats are drenched, the head should not be raised above a horizontal position, and the fluid should be given slowly. Administration should be stopped if much sneezing or coughing occurs. The safest method of giving fluid medicines is by stomach tube, but care must be taken, of course, that the tube enters the stomach rather than the lungs.

There is no known effective means for preventing chronic progressive pneumonia, as the cause is not known. When this form of pneumonia occurs, it is probably best to cull the visibly affected animals from the band for slaughter before the disease becomes advanced.

Exposure to cold, damp weather with poor or inadequate feed is a common exciting cause of acute pneumonia. Avoiding such conditions, so far as is possible particularly when shearing, dipping, and shipping, serves to prevent serious loss from this cause in most cases.

**TREATMENT.**—This is generally unsatisfactory. Provision of warm, well-ventilated but not drafty shelter and good nursing are, however, advantageous. There is nothing known to be of benefit for cases of chronic progressive pneumonia. Parasitic pneumonia may be improved to some extent by injection of various drugs into the trachea, but this is not generally practicable. On general principles, animals affected with any type of pneumonia should be isolated. A veterinarian should be called, if one is available, in order to avoid preventable serious losses.

#### POISONS AND POISONING

Poisoning of sheep and goats, as well as of other animals, may result from a variety of causes, the most important of which are damaged feeds, faulty medication, spray and dip residues, and poisonous plants. Some cases of poisoning are due to carelessness on the part of owners and herders and many could be avoided if more attention were paid to feeding and management practices.

The difference in the feeding habits of sheep and goats seemingly makes sheep more susceptible to poisoning, especially by some of the poisonous plants, although many cases of poisoning have been reported in goats. The latter animals are frequently run on ranges where sheep could not thrive.

##### Damaged Feeds

Under certain conditions hay that has become damaged and moldy after being stacked may prove to be poisonous. Although abortion is the most common result of feeding such a product, actual death

<sup>11</sup> For further information see Farmers' Bulletin 1330, Parasites and Parasitic Diseases of Sheep.

losses may occur in some cases. It is not known just what change takes place in damaged hay to render it toxic but it is better to discard the spoiled portions than to run the risk of loss.

Sheep are sometimes poisoned on ensilage that has become moldy and spoiled through exposure of air. Grain or other feeds may be rendered toxic by spoilage. It is usually considered unsafe to feed even small quantities of spoiled feed, especially to pregnant animals.

#### Faulty Medication

Sheep and goats are not often treated for the common ailments that affect these animals except in the case of internal parasites. Since most worm remedies are somewhat poisonous to the host as well as to the parasites, the directions for use should be closely followed to avoid loss from excessive doses.

Many common drugs and remedies are beneficial when given in proper dosage but are poisonous in an overdose. Even common salt is poisonous if consumed in excessive quantities. Treating so-called flyblows or other wounds with preparations not properly diluted may result in severe skin irritations or even in the death of animals.

#### Spray or Dip Residue

Pasturing animals in orchards, following fruit-tree spraying, may result in poisoning as some of the material used for this purpose is also poisonous to animals. Variable quantities of it commonly drip onto the vegetation under the trees where it is readily available to grazing sheep and goats. Weed sprays also may be dangerous to animals since they impart a salty taste to the sprayed vegetation and may be eaten on this account when ordinarily such plants would not be grazed. Unused materials left over from such operations should not be left where animals can gain access to them.

Sheep dipped in an arsenical solution should be kept in the draining pens until all surplus dip has drained away, since vegetation on which this material has dripped may contain sufficient poison to be dangerous. Drainage from the vat and unused material, if accessible to livestock, may also be dangerous.

#### Poisonous Plants

Poisonous plants constitute the principal source of poisoning and are responsible for considerable livestock losses in most of the sheep and goat raising sections of the United States. The greatest loss occurs in the western range States where sheep raising is a major industry and where much of the natural vegetation consists of low-grade forage plants with poisonous species often present. In the mountainous and wooded areas of the East a somewhat similar condition exists. On cultivated pasture lands the type of vegetation is largely under the control of the owners and poisonous plants can more easily be eliminated.

Very few poisonous plants are sufficiently palatable to be eaten by animals in preference to good forage so that the control of losses due to this cause is very largely a matter of proper range and pasture management. When an adequate supply of desirable forage is available and the animals are given an opportunity to select their feed

there is no great danger from eating poisonous plants in sufficient quantities to cause injury.

Animals that become very hungry, as they frequently do at shearing time and during shipping or when driven over trails where insufficient feed is available, are apt to eat the plants that are the most readily accessible, regardless of their quality. Under such circumstances heavy losses frequently occur, most of which could be avoided by keeping animals away from areas where poisonous plants are growing until their appetites are at least partially satisfied.

Overgrazing is probably the greatest single cause of stock poisoning by plants. On overgrazed areas the better class of forage is eaten first and, when this is gone, only the undesirable and poisonous species remain. During recent years a number of plants that have been reported as poisonous caused no trouble until after the ranges had become depleted.

Eradication of poisonous plants is not generally practicable except on cultivated areas or where they have a limited distribution on ranges having high forage yields. On many of the sheep and goat ranges, especially in the West, poisonous plants have such a wide distribution on areas capable of producing only a limited supply of forage that the cost of eradication would be prohibitive. But where the eradication of plants from limited areas would render larger areas safe for livestock, such a procedure may often be feasible. This has been demonstrated by the eradication of the tall larkspur from a number of areas on the national forests of the West where cattle losses have been materially reduced.

There is a general belief that goats are not so susceptible as sheep to the toxic effects of plants. However, the limited experimental work that has been done with goats indicates that these animals are affected in much the same manner as sheep when fed similar quantities of poisonous plants.

Many poisonous plants are eaten only when no other forage is available, and some of the low-grade forage plants are toxic when consumed in large quantities. These constitute local problems that may be corrected by proper feeding and management. In the following discussion of different poisonous plants only the more important ones are included.

#### Lupines (*Lupinus* Sp.)

The various species of lupines are widely distributed. Some are very toxic, some are only slightly toxic, and others are considered fairly good forage. Certain lupines are poisonous during the entire growing season while others are toxic only after the pods are formed. Sheep are more frequently poisoned than other animals although a few species of lupine are apparently more poisonous for cattle than for sheep.

**SYMPTOMS.**—The symptoms usually found in lupine poisoning are nervousness with a tendency to keep moving, difficult respiration, and later, convulsions and coma.

**PREVENTION.**—No treatment has been found that is effective in aiding recovery. To avoid losses from this source it is necessary to keep sheep away from areas of poisonous lupine, especially when the animals are very hungry.

Milkweeds (*Asclepias* Spp.)

The most important of the poisonous milkweeds are *Asclepias labri-formis* of southeastern Utah; *A. galioides*, or whorled milkweed of Colorado, Utah, Arizona, and New Mexico (fig. 7); *A. eriocarpa*, or



FIGURE 7.—The whorled milkweed (*Asclepias galioides*) of the Southwest.

woolly-pod milkweed of California; and *A. mexicana*, or Mexican whorled milkweed of the Pacific Coast States, Nevada and Mexico.

Milkweeds are not palatable and are seldom eaten except by very hungry animals. The leaves of these plants retain much of their toxicity upon drying or at maturity so that they are poisonous at any time.

**SYMPTOMS.**—The symptoms usually consist in forced and shallow respiration, staggering movements, falling with eventual inability to rise, and violent spasms that may continue until death (fig. 8).

**PREVENTION.**—Since no treatment is effective, the control of losses

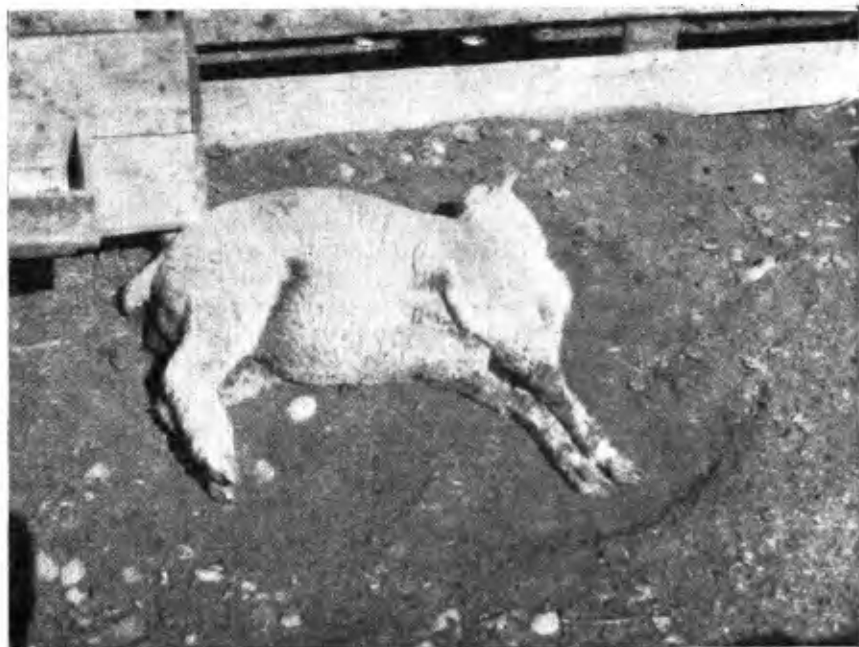


FIGURE 8.—A sheep poisoned by whorled milkweed, which causes severe convulsions. Note that the ground has been swept by the convulsive movements of the head and legs.

depends on preventing animals from eating these plants in toxic quantities. Even hay that contains much of these plants is dangerous.

**Pingue (*Actinea Richardsoni*) and Bitter Rubberweed (*A. Odorata*)**

During recent years these two species of *Actinea* have spread extensively in many areas and are causing heavy losses. Overgrazing has been an important factor in their spread and when other feed is not available these plants will be eaten. Either an acute or chronic poisoning may occur, depending on the quantity of plant eaten daily. The symptoms are similar in either case and consist in nausea, vomiting, depression, and weakness.

When ranges have become heavily infested with these plants it is difficult to utilize them without considerable loss. Regulated grazing that will permit the increase of other vegetation appears to be the most satisfactory method of controlling losses.



Sneezeweed (*Helenium Hoopesi*)

Western sneezeweed has been a problem on some of the higher mountain ranges for many years. In some areas sheep will begin eating these plants early in the summer within 2 or 3 weeks after going on the range, whereas in other areas the plants are not eaten until after frost occurs in the fall. Where an abundance of desirable browse plants is available there is less danger from sneezeweed. If browse is not available on sneezeweed range it is advisable to move sheep to browse range for 2 or 3 days at intervals of 2 or 3 weeks during the summer.

The most common symptom of sneezeweed poisoning is vomiting or spewing. In chronic poisoning there may be coughing and a general wasting away.

Deathcamas (*Zygadenus* Sp.)

Several species of deathcamas are poisonous and, when animals are turned on a range too early in the spring before sufficient feed is available, severe losses may occur. The species usually involved are the meadow deathcamas (*Zygadenus venenosus*) of the Northwestern Pacific Coast States, grassy deathcamas (*Z. graminus*) of Montana and Wyoming, foothill deathcamas (*Z. paniculatus*) of Utah and Nevada, and Nuttall's deathcamas (*Z. nuttallii*) of Oklahoma and adjacent parts of Texas and Kansas. The symptoms of deathcamas poisoning are salivation, nausea, vomiting, and prostration.

## Locoweeds

Most of the losses from locoweeds have occurred in the Western Plains States and in the Southwest. The principal species involved are the white loco (*Oxytropis lamberti*), the purple or woolly loco (*Astragalus mollissimus*), the Big Bend loco (*A. earlei*), and the blue loco (*A. diphysus*). The palatability of these plants varies considerably but generally they are not eaten in toxic quantities when other feed is available.

Since the majority of locoweeds are green during the winter, or start growth early in the spring, they are available before other plants have started and, being green and succulent, they are attractive to grazing animals.

Other species of *Astragalus*, known as poisonvetch, are poisonous to sheep but the condition produced is different from locoism.

**SYMPTOMS.**—Loco poisoning results from eating the plants over a considerable period of time, and the symptoms in sheep and goats are general unthriftiness, weakness, and paralysis.

## Heaths (Laurels)

Several members of the heath family are poisonous to sheep and goats and may be eaten in toxic quantities when other feed is scarce, especially in the winter and early spring. The leaves of these plants are tough and leathery and, as a rule, are not readily eaten.

The principal plants of this group are mountain laurel (*Kalmia latifolia*), sheep laurel (*K. angustifolia*), the drooping leucothoe (*Leucothoe catesbaei*) and staggerbush (*Lyonia ligustrina*), in the Eastern States; and western azalea (*Rhododendron occidentale*), the coast rhododendron (*R. macrophyllum*), and blacklaurel (*Leucothoe davisiae*) in the Pacific Coast States.

**Greasewood (*Sarcobatus Vermiculatus*)**

Under normal conditions and when taken with other feed greasewood is grazed quite extensively without apparent injury; however, extensive losses have occurred when hungry sheep have eaten rather large quantities of the plant in a short time. The substance in the plant that causes poisoning is oxalic acid.

Greasewood poisoning frequently occurs on western ranges following shipment or while sheep are being trailed. Poisoned animals will usually die, often without showing any characteristic symptoms.

**Paperflower (*Psilostrophe Spp.*)**

During recent years considerable loss of sheep has been caused by these plants. *Psilostrophe sparsiflora* is found in southern Utah and Arizona, *P. tagetinae* from southern Colorado to western Texas, and *P. gnaphalodes* in western Texas.

The heaviest losses occur in early spring and in the fall as the young growth is more toxic than the flowering plants. It usually requires a week or more after sheep begin eating the plants before symptoms appear, and in order to stop the loss it is necessary to move the herds to ranges practically free of the plants.

The symptoms, which consist in depression, weakness, and general debility, usually develop gradually and many animals may be affected before the condition is noticed.

**Copperweed (*Oxytenia Acerosa*)**

This plant grows abundantly in areas drained by the Colorado River, in alkaline soil along stream beds and in seepage areas. Although copperweed is most toxic in the fall as the plants reach maturity, it is poisonous most of the year, either green or dry. This plant is not palatable and is grazed only when better forage is not available.

Symptoms usually consist in depression, weakness, incoordination, and coma, and these may appear within a few hours after the plants are eaten. It is not unusual to find animals dead in the morning that were apparently well the night before.

Losses may be controlled by keeping sheep away from areas where the plants grow or by providing suitable feed.

**Rayless Goldenrod (*Aplopappus Heterophyllus*) and White Snakeroot (*Eupatorium Rugosum*)**

Although very different in appearance and found in widely separated parts of the United States, these two plants contain the same poisonous substance. Rayless goldenrod grows in the Southwest and causes the disease known locally as alkali disease, whereas white snakeroot is found in the Central and Eastern States and is the cause of so-called trembles, or milksickness.

The toxic substance found in these plants may be transmitted through the milk of lactating animals and affect the offspring. Since human beings may also contract the disease it is dangerous to use the milk of any animals poisoned by these plants.

**Waterhemlock (*Cicuta Sp.*)**

Plants of this species grow along streams and ditches and are probably the most toxic of the poisonous plants. Since waterhemlock can

be eradicated by grubbing, this should be done and the roots disposed of in such a manner that livestock cannot reach them.

**Poisonhemlock (*Conium Maculatum*)**

Poisonhemlock appears to be spreading in many areas and, while the plants are not palatable and are not readily eaten by livestock, some loss has been reported from this source. When animals are very hungry or other feed has matured and dried these plants may be eaten since they usually produce green foliage until fall.

**Cocklebur (*Xanthium* Sp.)**

Although not readily eaten under normal conditions, young cocklebur plants in the cotyledon stage are toxic for livestock. These plants often grow in profusion around the margins of receding reservoirs or other moist places, and if hungry sheep are driven onto such areas there is a possibility that sufficient quantities may be eaten to cause poisoning.

**Coffee Bean (*Glottidium Vesicarium*) (*Sesbania Vesicaria*) and Rattlebox (*Daubentonia Drummondii*) (*Sesbania Drummondii*)**

The seeds of these closely related plants are toxic, probably to all classes of livestock. *Glottidium vesicarium*, which is the more toxic of the two, grows in the Southern States from South Carolina and Florida to Texas and Oklahoma. *Daubentonia drummondii*, also known in some localities as coffee bean, grows in the Gulf States as far west as central Texas.

Both plants are irritant to the digestive tract and produce severe diarrhea. The heart and respiration also are affected. Death may occur within a day or two after the beans are eaten, and recovery may be slow in animals that survive.

**Cyanogenetic Plants**

Plants that are poisonous because of their hydrocyanic acid or cyanide content are known as cyanogenetic plants. Of these wild cherry (*Prunus virginiana*, *P. melanocarpa*) and arrowgrass (*Tri-glochén maritima*) are dangerous at any time during the growing season; sorghum (*Sorghum vulgare*), Johnson grass (*S. halepense*), Sudan grass (*S. vulgare* var. *sudanense*), and velvet grass (*Holcus lanatus*) become toxic under certain conditions affecting growth such as freezing, trampling, wilting, or second growth. The young growth of sorghum is more toxic than older plants, but when cut and cured for hay or silage the toxicity is largely lost.

In order to result in poisoning a sufficient quantity of the toxic material must be eaten in a short time to cause the hydrocyanic acid concentration in the blood to reach a certain level. Smaller amounts may be eaten over a longer period of time without producing symptoms, as the poisonous substance is eliminated rapidly from the body.

The usual symptoms of poisoning from cyanogenetic plants are uneasiness, rapid respiration, increased pulse rate, depression, stupor, convulsions, cyanosis or blueness of the mucous membranes, paralysis, and death. Death may result within a few minutes to several hours after the plants have been eaten.

Treatment consists in the intraperitoneal or intravenous injection of a mixture of sodium nitrite and sodium thiosulfate but, since this should be given by a veterinarian, the remedy is seldom available at the time needed.

Most of the loss from cyanogenetic plants on the western ranges comes from eating wild cherry. Again, poisoning is more apt to occur when animals are hungry and other feed is scarce.

#### Photosensitizing Plants

A number of plants found in different parts of the world, when eaten under certain conditions, will sensitize animals to the action of light. This condition, known as photosensitization, affects the skin of white or light-colored animals and produces an edematous swelling and dermatitis, or inflammation of the skin.

The principal plants in the United States producing this condition are *Agave lophantha poselgeri* (*A. lecheguilla*) which causes the lechuguilla fever of western Texas, *Nolina microcarpa* (*N. texana*) and (*N. greenei*) that cause sacahuiste poisoning or swellhead in New Mexico and western Texas, and *Tetradymia glabrata*, commonly known as coal oil brush or littleleaf horsebrush (fig. 9, A) and *T. canescens* var. *inermis*, or spineless horsebrush (fig. 9, B) that are the principal causes of range bighead (fig. 10) in the Intermountain Region. Plants of lesser importance are *Hypericum perforatum* or St. Johnswort of the Northwest, and buckwheat and alsike clover in the Central and Eastern States. Other plants have been known to produce a similar condition in this country, but definite experimental evidence regarding the action of most of these is lacking.

In lechuguilla fever, sacahuiste poisoning, and tetradymia poisoning the edema or swelling of the skin and subcutaneous tissues is the visible evidence of photosensitization but, while this condition is frequently present, especially in tetradymia poisoning or bighead, it does not necessarily follow poisoning by the respective plants. The edema or swelling affects only the white portions of the skin and is usually located in the ears, face, lips, and under portion of the neck. In severe cases of bighead the head and neck may become swollen to enormous proportions, and, at times, the skin along the back may become swollen and sensitive.

The primary effect of the toxic substances in these plants appears to be on the liver and kidneys. Black animals are similarly affected except that the skin pigment protects them from the action of light, which is a necessary factor in producing the edema. Icterus or jaundice is present in lechuguilla fever and sacahuiste poisoning but is seldom seen in tetradymia poisoning, and then only to a slight degree.

The factors contributing to photosensitization following plant poisoning are not entirely understood, although it is generally recognized that a certain amount of green feed is essential, and that animals be exposed to light.

Lechuguilla poisoning is usually the result of poor range conditions when good forage is scarce and the animals are forced to feed on inferior and poisonous plants. The lechuguilla plant is coarse and fibrous and is not eaten from choice. Prevention of losses, therefore, depends upon the provision of suitable feed throughout the year.

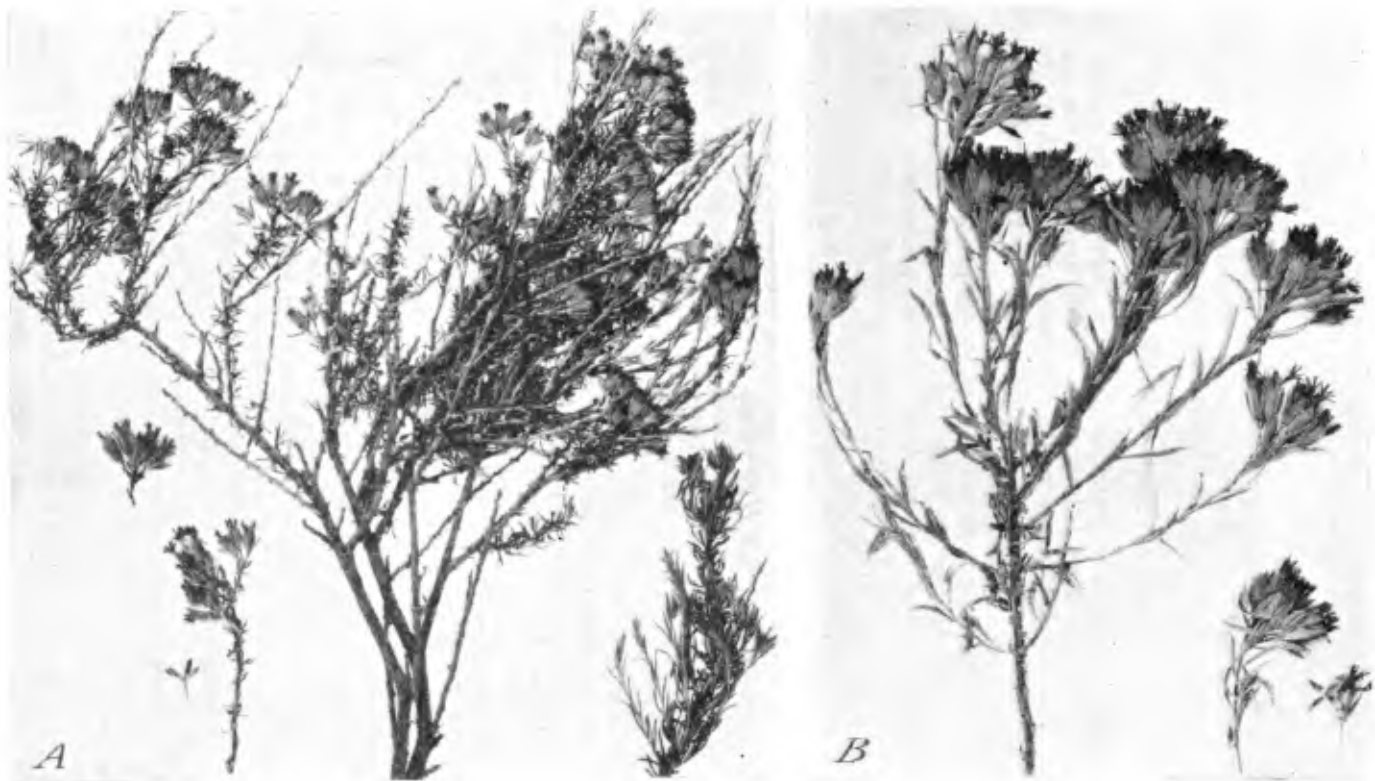


FIGURE 9.—Two plants that cause bighead: A, Littleleaf horsebrush (*Tetradymia glabrata*), also known as spring rabbitbrush and coal oil brush; and B, spineless horsebrush (*Tetradymia canescens*)

Sacahuiste poisoning results from feeding on the buds and blossoms of the sacahuiste plants. As with most poisonous plants, small quantities may be eaten without injury, but, since these are palatable, it is necessary to manage the bands in such a way that a toxic quantity is not eaten.

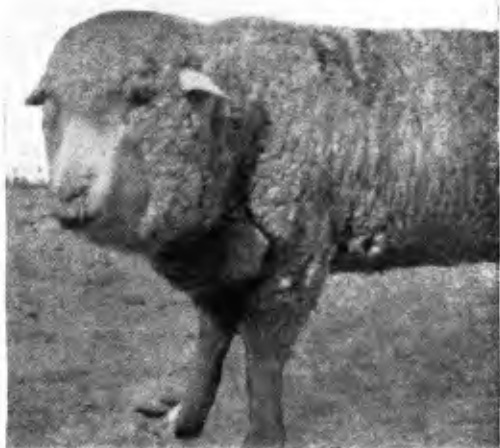


FIGURE 10.—A sheep affected with bighead.

**Tetradymia** poisoning or bighead is essentially a trail disease and most outbreaks occur when herds are being moved. *Tetradymia glabrata* and *T. canescens*, var. *inermis* are not sufficiently palatable, especially the former, to be eaten except under very adverse range conditions or when sheep are extremely hungry. Single feedings of a toxic quantity are sufficient to produce the disease which usually develops rapidly. The first indication of an outbreak may be uneasiness and evidence of skin irritation about the head, and this is followed within a few minutes or hours by the swelling or edema which is generally considered the characteristic symptom of the disease. The symptoms of photosensitization usually develop in from 12 to 24 hours after a toxic dose of the plants has been eaten, although in some outbreaks numerous deaths occur before any of the sheep develop the edema.

The prevention of bighead is dependent upon such herd and range management as will avoid the use of areas where either of these two species of *Tetradymia* exists when other feed is scarce or when the animals are very hungry. This is especially important while the sheep are being trailed.

There is no specific treatment for bighead, but if the affected animals can be provided with shade, water, and a small quantity of desirable feed and then disturbed as little as possible, the chances of recovery are increased.

Sweetclover (*Melilotus albus*—White sweetclover; *Melilotus officinalis*—Yellow sweetclover)

In late years sweetclover has become an important forage crop, especially in some sections of the country. In the form of hay, it is gen-

erally considered to be inferior to alfalfa or other clovers, but it has become an important pasture crop in some areas. Owing to the nature of the plant, sweetclover is difficult to cure properly as hay or silage. When spoiled, it is likely to cause so-called sweetclover disease in animals to which it is fed. Cattle are most often affected, though sheep and goats may be poisoned occasionally. Young animals appear to be more susceptible than old ones.

Sweetclover poisoning is characterized by failure of the blood to clot. When bleeding occurs, as in parturition, or from an operation, such as castration, it may continue till the animal dies. Hemorrhages may also occur, however, without the latter provocations; the blood escapes into the body cavities, or the muscles, or under the skin. The resulting swellings have on numerous occasions been mistaken for blackleg by uninformed persons.

The condition is most likely to occur when animals are fed continuously on damaged sweetclover hay or silage and when they are fed for a considerable time. In cattle, hemorrhages may occur as early as 3 weeks but usually not until after a month or more of feeding. Experimentally fed sheep have never shown symptoms in less than 30 days and some have been fed toxic clover for as long as 9 months without developing symptoms.

It is difficult, if not impossible, to recognize toxic sweetclover hay without experimental feeding. Spoiled hay is always potentially dangerous, but some that appears to be well-cured may produce the disease. Rabbits may be used as test animals, since they are very susceptible to sweetclover disease. They may be affected in as short an interval as 6 days of feeding very toxic hay, while they may go a month and a half in some cases on hay of low toxicity. As rabbits are nearly always poisoned before cattle or sheep on the same feed, it may be withheld from the larger animals if the rabbits develop the disease. Danger may be somewhat minimized by feeding the hay with at least twice as much of some other kind of roughage, or by feeding it for periods not exceeding 10 days, then feeding other roughage for 10 days or 2 weeks before again feeding sweetclover. Sweetclover that is toxic for other animals might be fed to horses, since they are not susceptible to sweetclover disease. If the disease is not too advanced, some animals may be saved by blood transfusions.

#### Salt Poisoning

Sheep and goats, like all animals, require common salt for good health. It should be available at all times so that it may be eaten in such quantities as are required. However, animals may be poisoned, if, after an extended period of deprivation, they are allowed unrestricted access to salt.

Large quantities of salt cause gastrointestinal irritation which results in diarrhea. Trembling of the lips and other nervous symptoms may develop. Leg weakness and inability to stand sometimes occur. Death may occur in extreme cases, though the great thirst which the animals develop causes them to drink large quantities of water, which constitutes the best known treatment. Unlimited access to clean water is therefore advised.

#### Plants Containing Selenium

Certain plants have the ability to absorb selenium when the soil contains sufficient quantities of this highly toxic element. Such vegetation is poisonous to livestock. The poisoning may be either acute or chronic depending upon the quantity of selenium present in the plants. The chronic type is the more common and is known in some localities as alkali disease.

The symptoms of the chronic type are irregular and deformed hoofs, lameness, bone deformity, loss of hair, unthriftiness, and emaciation.

#### Fluorine Poisoning (Fluorosis)

The element, fluorine, is a normal though apparently nonessential constituent of the animal body. It is widely distributed in nature and occurs in minute amounts in soil and water, as well as in plants. Animals are apparently not affected by these small quantities of fluorine, but in a few areas the element is found in larger quantities in the feed or water. As a result, the enamel of the teeth becomes pitted and rough, with small irregular whitish areas and patches of brownish-black discoloration. The teeth wear unevenly.

Fluorine is a cumulative poison; that is, it accumulates in the body, and long-continued consumption of small quantities results in chronic poisoning. This is evidenced by general unthriftiness, diarrhea, abnormalities of the teeth and bones, and unusual hunger for salt. In advanced cases the bones are enlarged and easily broken. Some cases resemble rickets. Sheep and goats apparently are less likely to be seriously troubled than cattle.

The greatest danger from fluorosis is in feeding crude rock phosphates or phosphatic limestone, which are frequently high in fluorine content. If such materials are fed as mineral supplements, only a purified product, low in fluorine content, should be used.

#### PREGNANCY DISEASE (BEFORE-LAMBING PARALYSIS)

This, like milk fever, appears to be the result of metabolic disturbance. As the name suggests, it is essentially an ailment of pregnant ewes, especially those carrying twins or triplets. The malady usually appears during the last month of pregnancy, more commonly in ewes 5 or 6 years old that are being maintained on dry feed with limited exercise. It may occur in small farm flocks or in range bands that are being fed preparatory to early shed lambing. An acute form of the disease may occur in range sheep during or immediately following shipment from the winter range to lambing ranges.

The exact cause of the disease remains undetermined, though the above-mentioned factors all appear to be more or less involved. An acid condition of the body (acidosis) develops and there is a decrease in the normal amount of blood sugar (hypoglycemia).

**SYMPTOMS.**—These are somewhat like those of milk fever. At first the affected animals stand off by themselves or lag behind the flock when being driven. Later they become dull and weak, urinate frequently, and grind their teeth. The breathing may become more or less accelerated and nervousness commonly develops. The affected ewe may be stupid or excitable, and appears to be blind. She refuses



feed and drinks little water, becoming weaker and weaker until she goes down after several hours or a day or two. Following this, the ewe may lie on the breast with the head turned toward the flank (fig. 11), or she may lie flat on the side, for days before death occurs. Without treatment, the great majority of the affected animals die, unless lambing should occur early in the course of the disease. Lambs so born are apt to be weak and unthrifty and in many cases die.



FIGURE 11.—Typical position of a ewe affected with pregnancy disease.

Upon post mortem examination of the ewe affected with pregnancy disease more than one lamb is found in the uterus in most cases. The most striking abnormality noted is the condition of the liver which is much thickened and light yellowish-brown in color. The kidneys are frequently pale and soft in consistency.

**PREVENTION.**—The disease can be largely if not entirely prevented by proper feeding and exercise. Pregnant ewes, if not on green pasture, should receive a liberal allowance of clean, bright, legume hay. In addition, grain should be fed, particularly during the last month or two of pregnancy. With the grain, small quantities of molasses, corn syrup, or pure dextrose may be given. Abrupt changes in feed are particularly undesirable during pregnancy. The quantity of grain to be fed should be varied considerably according to the condition of the ewes. If they are thin, a pound or even more per head may be allowed after they have become accustomed to the feed, while fat ewes may be somewhat more restricted. Exercise is essential. Rapid, forced driving should not be resorted to but the animals should be compelled to travel at least a half mile a day. To accomplish this, the animals may be fed at some distance from the barn or pen where they are kept at night. The object should be to bring the ewes up to lamb-

ing time in good thrifty condition, neither thin nor overly fat. Every effort should be made to maintain regular and adequate feeding, especially during inclement weather in the latter part of pregnancy.

**TREATMENT.**—Treatment of the disease as it occurs in the lambing shed is seldom successful, though some animals may recover if taken in hand early. Certain sugar solutions may be injected into the blood stream, or corn syrup, brown sugar, or pure dextrose may be given in the drinking water or as a drench. Treatment appears to be more successful in those cases which follow shipping.

#### PROLAPSE OF THE VAGINA OR UTERUS

This consists of the eversion and partial or complete extrusion of the vagina or uterus. Partial eversion of the vagina may occur before parturition in closely confined animals or complete eversion may take place after lambing. The condition is comparatively infrequent in ewes or does.

During labor, the rectum also may be everted. Prolapses of either sort should be promptly attended to before gangrene of the parts develops. If this is not done, death invariably results.

**TREATMENT.**—Constipation or diarrhea are common complicating conditions in cases of prolapse. These conditions, as well as the protruding organ, require attention. The prolapsed organs can usually be readily replaced if this is undertaken soon after the accident occurs. Cleanliness, dexterity, and gentleness are required. In some cases sedative drugs and suturing of the openings or the application of a truss may be required to retain the organs after they are replaced.

#### RHINITIS (NASAL CATARRH, SNUFFLES)

Sheep are prone to develop this condition, which is evidenced by running noses, sniffing, and sneezing.

The condition may be caused or aggravated by inhalation of dust from the trail, dry corrals, or forage. The condition always attends grub in the head and is a part of the clinical picture in various diseases of the lungs. Snuffles is commonly aggravated for a while following shearing and dipping.

Ordinarily, no treatment is necessary, but if the condition becomes severe, the cause should be determined and remedial measures may be advisable. Such may be the case in heavy grub infestation. A very effective treatment for head grubs has been developed. It consists of irrigation of the nasal passages with a 3 percent saponated cresol solution.<sup>12</sup>

#### RICKETS

Rickets is a nutritional disease of young, growing animals that results from deficiencies of calcium, phosphorus, or vitamin D. All three substances must be present for the development of normal bone. Even a moderate lack of one or all of these food elements may produce the disease.

**SYMPTOMS.**—Unthriftiness, stiffness, spasms, enlarged joints, and deformed, easily bent or fractured bones are common indications of the disease. The leg bones and ribs are most often visibly affected.

<sup>12</sup> Details of the treatment may be had upon application to the Zoological Division, Bureau of Animal Industry.

Kids are probably more commonly affected than lambs, though neither species often develops the disease except under unusual conditions of management. Improperly fed, closely housed orphans, or "bums," are especially apt to develop rickets unless care is taken.

Diseases like rickets sometimes develop in mature animals from essentially the same causes. Osteoporosis, osteomalacia, and osteofibrosis are diseases of this character. Symptoms suggestive of rickets may occur also in fluorosis, or fluorine poisoning.

**PREVENTION.**—To prevent rickets, feed containing the necessary nutrients is required, although vitamin D may be provided through either the feed or by liberal exposure of the body to direct sunlight. The minerals, calcium and phosphorus, which are essential for prevention of rickets, are present in normal milk; therefore nursing animals are unlikely to develop rickets. A liberal allowance of bright, sun-cured hay, particularly legume hay (alfalfa, lespedeza, clover, etc.), and daily exposure to direct sunlight are the most practical preventives of the disease. Winter sunlight, especially in northern latitudes, is less effective than summer sunlight.

**TREATMENT.**—The same measures that prevent rickets are applicable for remedy of the condition after it appears, but to be very effective treatment must begin early in the course of the disease. Providing access to sunlight and giving vitamin D, calcium, and phosphorus after the bones have become markedly deformed will usually lead to improvement, but complete restoration to normal condition cannot be expected in advanced cases. Cod-liver or other fish oils or irradiated yeast, which are rich in vitamin D, may be given if cases develop that do not respond readily to corrective feeding with sun-cured hays, or if direct sunlight is not available for extended periods because of inclement weather. Bonemeal contains calcium and phosphorus in the amounts generally required and may be combined with the salt the animals receive. In cases where calcium especially is required, ground limestone may be mixed with the salt. Special medication may be applicable in selected cases.

#### SKIN DISEASES

Scabies, or scab, should always be the first disease suspected when abnormalities of the skin appear in sheep or goats. A practicing veterinarian or official inspector should be notified immediately when unusual itching, scratching, or loss of wool or hair occurs.

The symptoms of diseases of the skin are of course variable, and considerable time and effort may be required to determine the exact nature and cause of the trouble. Aside from scab, which is the most important disease to be considered,<sup>13</sup> such conditions as pox, contagious ecthyma, ringworm, maggot infestation, lousiness, tick infestations, and pyogenic infections may be responsible. In addition, certain plants may induce various forms of irritation, either directly or indirectly (see Poisons and Poisoning). A condition called eczema, wool rot, or rain rot, sometimes occurs in long-wooled or medium-wooled sheep in a poor state of nutrition when they are continuously exposed to wet weather for long periods. There is considerable rubbing and scratching, the fleece becomes ragged and stringy, and patches of the

<sup>13</sup> For further information see Farmers' Bulletin 713, Sheep Scab.

wool fall off. Sheep not infrequently shed their wool after severe, protracted febrile diseases or poisoning. With the return of general health new growth of wool usually takes place.

Treatment of skin diseases depends on the nature of the underlying trouble, the determination of which is essentially a veterinarian's task.

#### STIFF LAMBS (WHITE-MUSCLE DISEASE)

The term "stiff lamb" is commonly applied by sheepmen to any condition in which lameness occurs. As here used it applies to a disease in which the muscles are affected by a peculiar grayish-white discoloration and degeneration, an abnormality separate from such conditions as arthritis (joint ill) and tetanus.

**CAUSE.**—Stiffness occurs in many diseases of lambs of various ages: white-muscle disease occurs in lambs 3 to 10 weeks old. Most cases occur in lambs born in the winter and early spring, under conditions where more or less continuous shelter is necessary and both exercise and variety of feed are commonly more or less restricted. So far as has been determined, the disease is caused by some of these conditions, but has not yet been exactly classified, except that it is generally conceded to be noninfectious. The disease seldom if ever occurs in lambs born and raised on the range.

Improper balance of calcium and phosphorus in the ration, certain vitamin deficiencies, and autointoxication have all been considered as possible causes.

**DIAGNOSIS.**—The diagnosis of the disease is practically confined to post mortem examination. White or grayish streaks are found in the muscles, particularly in the legs. These have a characteristic appearance microscopically. There is some evidence that the microscopic changes may be found even before stiffness appears.

**PREVENTION.**—There is no known successful method of treatment though apparently the disease can be largely prevented by good management and feeding a nutritious, but not too concentrated ration. Wherever possible ewes, if not on adequate, nutritious pasture, should receive a liberal allowance of clean, bright, legume hay, preferably alfalfa. Attention should be paid to the general nutrient balance of the ration, including mineral and vitamin constituents.

#### TICK PARALYSIS

This condition has been observed from time to time in sheep, as well as other animals, on the western ranges. It occurs in the spring and early summer season when mature ticks (*Dermacentor andersoni*, and possibly other species) are active.

Affected animals show such nervous symptoms as restlessness, frenzy, staggering, and finally progressive paralysis. Ticks engorged with blood may be few or numerous on affected animals. The condition is attributed to some unidentified poisonous substance, or toxin, secreted by the ticks, while attached and feeding, and their removal usually results in recovery of the animal in a few hours to a day. If the ticks are removed by hand, thumb forceps, or tweezers, should be used, since *Dermacentor andersoni* may be infected with Rocky Mountain spotted fever virus or *Pasteurella tularensis*, both of which are dangerous for

man. The hands should be thoroughly washed afterward, the forceps should be boiled, and the ticks should be destroyed, preferably by burning.

Tick paralysis should not be confused with tularemia, which is a specific infectious disease, that may, however, be transmitted by the same ticks causing tick paralysis.

#### WOUND INFECTIONS

Wounds, whether accidental as from shearing cuts, dog bites, injury from fences, and similar causes, or intentional as from marking, docking, castration, or vaccination operations, are to be looked upon as potential avenues for the entrance of disease-producing bacteria. Some bacteria, such as *Corynebacterium ovis* the cause of caseous lymphadenitis previously discussed, are seldom fatal but nevertheless needlessly wasteful. Other diseases, such as blackleg, due to *Clostridium chauvoei* and other related organisms, tetanus or lockjaw, caused by the toxin of *Clostridium tetani*, and malignant edema, produced by *Clostridium septicum*, are of more or less frequent occurrence and they are almost invariably fatal.

Common sources of blackleg, malignant edema, and tetanus are present in barnyard, corrals, or pastures long used by livestock. A circumstance under which they commonly occur is where sheep are dipped for scab, lice, or sheep ticks (*Melophagus ovinus*), immediately after shearing. Too often this is a careless operation resulting in frequent scratches and cuts of the animals' skins and the dips serve to form a sort of seal over the wounds beneath which the organisms may thrive. When this occurs, the results are disastrous, as treatment is generally ineffective after disease once develops. Careful operators avoid these losses by insisting upon gentleness and care by shearers. If cuts result, as they will at times in the haste of the operation in spite of all precautions, the wounds should be treated immediately with a reliable antiseptic. Perhaps the best of these under average conditions is tincture of iodine, U.S.P.

Blackleg, so-called because of the common localization of apparent lesions in one of the legs when it occurs in cattle, may be manifested by swellings on any part of the body of sheep, usually though not always in the region of a recent wound. The disease may occur in ewes as a result of infection of wounds of the genital tract produced at lambing time. Cases in rams have been observed in which the lesions appeared about the head as the result of infection of wounds acquired through butting when fighting. Pressure or manipulation over the swellings usually causes a crackling sound due to the movement of the entrapped gas formed by the germs. The swellings are usually hot and painful. They are essentially dry as may be observed on post mortem examination, the tissues being almost black in color and infiltrated with gas bubbles. Vaccination, as in cattle, is effective in preventing the disease. In case of an outbreak, however, it is very desirable whenever practicable to determine the exact type of the infection present, in order that the properly constituted vaccine can be used.

In tetanus, prolonged, severe muscular spasms occur, resulting in intense rigidity of certain parts or practically the entire body. The disease may be prevented by the use of tetanus antitoxin, the effect

of which is prompt, but not lasting. Tetanus toxoid is used particularly in regions or on premises where the disease is known to be prevalent, as it produces a more lasting immunity.

Malignant edema is, like blackleg, one of the so-called gas edema diseases and is sometimes manifested by symptoms resembling those of blackleg. In fact the organisms which cause the disease are sometimes present in what clinically appears to be blackleg. Usually, however, the lesions are largely composed of blood-stained, watery infiltrations of the tissues, as distinguished from blackleg with its darker, drier, gaseous lesions. Preventive vaccination against this disease is not often practicable.

Treatment of acute wound infections is seldom feasible, but, with the application of ordinary sanitary precautions, most of the losses from these sources may be avoided.

Direct counsel from a veterinarian entirely familiar with operations practiced on the particular ranch or farm should be obtained to aid in the prevention of these as well as other diseases. The carcasses of animals dying from blackleg particularly should be as meticulously disposed of as those of animals dying from anthrax. Actually, however, it might be stated axiomatically that all animals dying of any disease should be so handled, unless the veterinarian specifies other measures for special reasons.

#### WOOL AND DIRT EATING

Young lambs up to several weeks of age frequently eat strands of wool and other foreign substances which may form small balls or wads in the stomach. These may lodge in the outlet and prevent the passage of food from the stomach to the intestines and result in a toxemia caused by the absorption of toxic products formed in the overloaded stomach. This condition is usually considered to be the result of an acquired habit, but it may be due also to a nutritional deficiency in the diet of the ewes before birth of the lambs and during the nursing period. This dietary deficiency may be the cause of a depraved appetite in the lambs, inducing them to eat these foreign substances.

Affected lambs stop nursing, appear dull and weak, usually have a slightly distended abdomen, and lie around quietly most of the time. There is no known effective treatment, and such lambs seldom live longer than a day or two after symptoms develop. Post mortem examination will usually reveal the presence of the wool ball at the outlet to the stomach, although this material may become mixed with the stomach contents and be difficult to detect unless this organ is handled carefully during its removal.

The eating of wool, dirt, and other injurious substances may be prevented to a considerable extent by providing feed in creeps located in readily accessible places so that the lambs will start eating at an early age. The feed may consist of a mixture of grains, such as cracked corn, rolled or crushed oats, and wheat bran.

When the ewes have been provided with a well-balanced ration, which must include the essential minerals, during the period preceding lambing and until the lambs reach an age when they will take the usual feeds, there is less danger of loss due to lambs eating indigestible substances.